SEATON BEACH MANAGEMENT PLAN

Options Appraisal Report - Axmouth Harbour

Prepared for

East Devon District Council

February 2019

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Contents

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Document History

Reference Number: **694226**

Client Name: East Devon District Council

This document has been issued and amended as follows:

Version	Date	Description	Created By	Verified By	Approved By
v2	28.02.2019	Draft	Emma Allan	Alan Frampton	Alan Frampton

Executive Summary

This report has been prepared for East Devon District Council, and their partner, the Environment Agency, as part of the Seaton Beach Management Plan (BMP). The BMP area covers the coastline from Seaton Hole in the west, to the Harbour Wall on the east side of the River Axe, and the Axe River up to the Axe Bridge.

This Options Appraisal Report for Axmouth Harbour is a supporting document to the Seaton BMP (Jacobs, 2018b). As documented in the BMP, the report has been published some time later owing to additional information required related to licensing approvals.

Dating back to the 1970s, material has been dredged from the Axe Estuary to form what is now the Axe Harbour basin, with further modifications to Seaton spit and western bank of the Axe Harbour, including the construction of various ad-hoc defences on the landward side of the spit, in order to stabilise the bank and thereby maintain the harbour. The dredged material has been disposed of within trenches dug into Seaton spit. More details are provided in the Seaton BMP (Jacobs, 2018a) and the Coastal Processes and Defence Baseline Reports, which are appended to this report for reference (see Appendix A and Appendix B respectively).

There are now concerns that this practice is threatening the integrity of the seawall at Seaton and the spit itself. In recognition of this, and in line with the aims and objectives of the BMP, formal consideration of dredge disposal options has been undertaken as part of developing the BMP and an appropriate management regime for Axmouth Harbour has been defined.

The selection of a preferred management approach for Axmouth Harbour was undertaken via a staged approach, which rationalised a long-list of options to a short-list of options, from which a preferred option was selected.

As part of this process, ongoing and detailed consultation was undertaken with Natural England and the Marine Management Organisation, and its consultees, as part of a dredge disposal licence application process. This is documented in detail within this report.

For Axmouth Harbour, the long-list consisted of 14 options. The long-list of options was then appraised, and via a process of consultation and discussion, was ratified to a single preferred option.

The preferred option for Axmouth Harbour is: **Option 6: Deposit dredge material within spit below Mean High Water Springs**.

SECTION 1

Introduction

1.1 BMP Area, including Axmouth Harbour

This report has been prepared for East Devon District Council (EDDC), and their partner, the Environment Agency, as part of the Seaton Beach Management Plan (BMP). The BMP area covers the coastline from Seaton Hole in the west, to the Harbour Wall on the east side of the River Axe, and the Axe River up to the Axe Bridge, as shown in Figure 1-1.

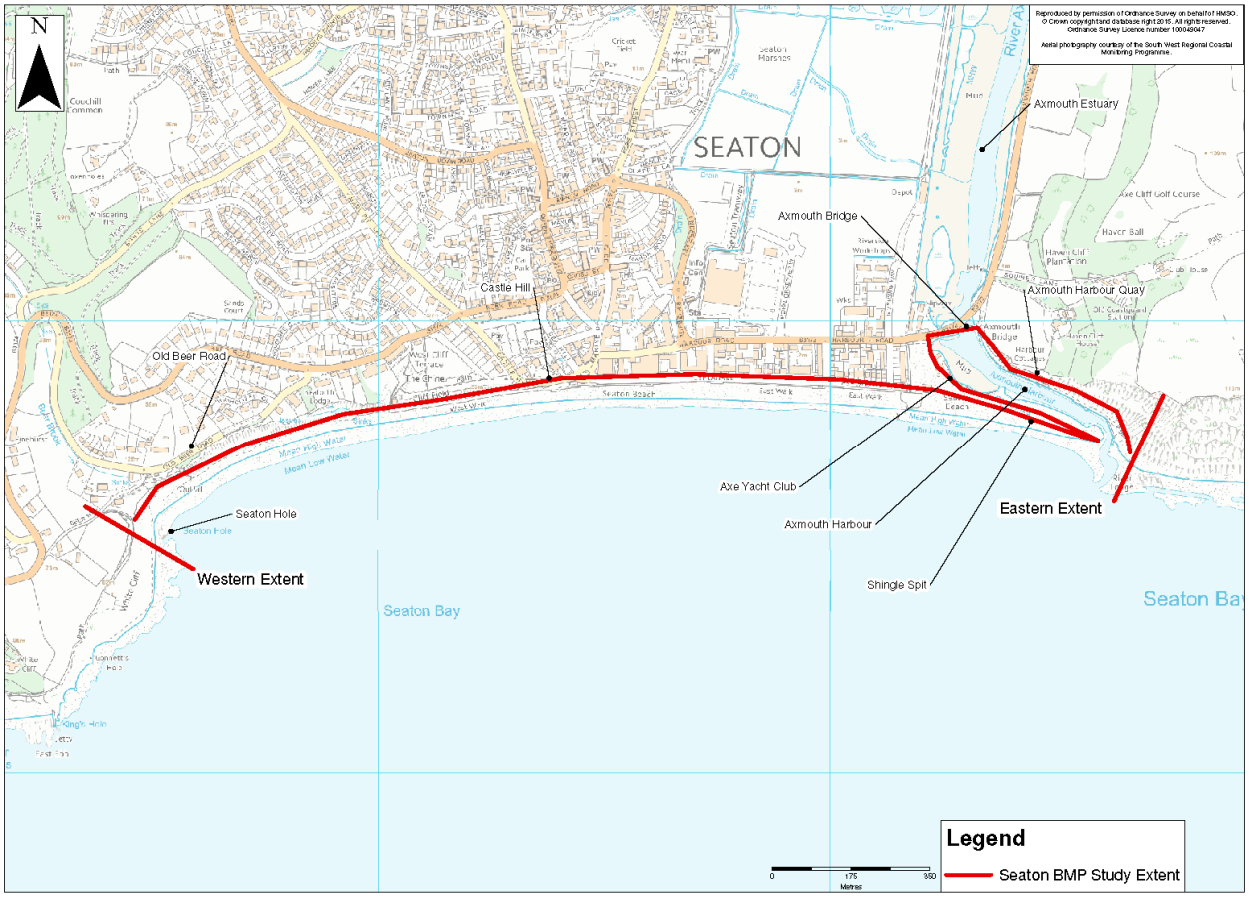

Figure 1-1 Seaton BMP area

1.2 The Basis of this Report

This Options Appraisal Report for Axmouth Harbour is a supporting document to the Seaton BMP (Jacobs, 2018a). As documented in the BMP, the report has been published some time later owing to additional information required related to licensing approvals.

Dating back to the 1970s, material has been dredged from the Axe Estuary to form what is now the Axe Harbour basin, with further modifications to Seaton spit and western bank of the Axe Harbour, including the construction of various ad-hoc defences on the landward side of the spit, in order to stabilise the bank and thereby maintain the harbour. The dredged material has been disposed of within trenches dug into Seaton spit. More details are provided in the Seaton BMP (Section 3.2.3).

There are now concerns that this practice is now threatening the integrity of the seawall at Seaton and the spit itself. In recognition of this, and in line with the aims and objectives* of the BMP, formal consideration of dredge disposal options has been undertaken for the current BMP and an appropriate management regime for Axmouth Harbour has been defined.

**Full details on the aims and objectives of the BMP and how it has been developed are provided in the Options Appraisal Report (Jacobs, 2018b). The second of the four BMP objectives is to determine an appropriate management regime for Seaton spit.*

This report provides details on the selection process for a preferred management approach for Axmouth Harbour.

1.2.1 Development of Dredge Disposal Options

The selection of a preferred management approach for Axmouth Harbour was undertaken via a staged approach, which rationalised a long-list of options to a short-list of options, from which a preferred option was selected. This is shown in Figure 1-2, and references to the relevant sections within this report are as follows:

- Long-list appraisal (described in detail in Section 2).
- Short-list appraisal (described in detail in Section 3); and
- Selection of the preferred option (described in detail in Section 4).

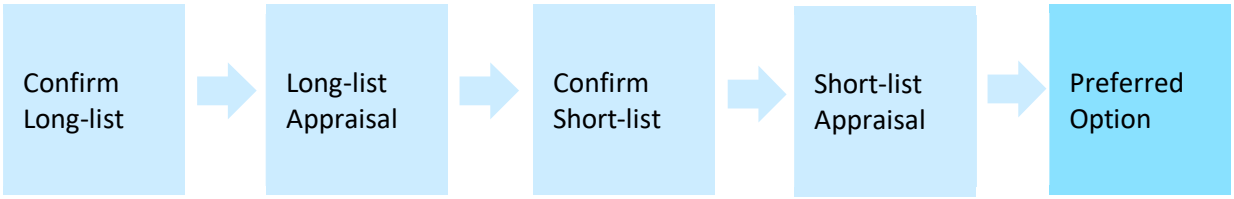

Figure 1-2 Options appraisal process – staged approach to option selection

The options appraisal is underpinned by the information and evidence presented in the four baseline studies:

- Coastal Processes Baseline: coastal processes, shoreline interactions and shoreline evolution (presented in Appendix A).
- Environmental Baseline: environmental setting and features (presented in Appendix B).
- Defence Baseline: coastal defence assets, condition and performance (presented in Seaton BMP - Appendix C).
- Economics: dredging of the Axe Estuary is undertaken and solely funded by the Axe Yacht Club. At present, there are, in general, no opportunities for funding for maintenance works from elsewhere. As part of the options assessment, a high-level assessment on the affordability of each option was undertaken.

SECTION 2

2 Long-List Options Appraisal

2.1 Derivation of the Long-List

The initial stages of the options appraisal processes were completed for Axmouth Harbour alongside the options appraised for the wider BMP frontage; refer to the BMP Options Appraisal Report (Jacobs, 2018b).

All possible options for the dredging and disposal of dredge material within the BMP area have been identified using the following information and summarised as the 'long-list':

- Baseline reports (coastal processes, environmental and defence).
- Feedback provided from a BMP public consultation events held on the 25th May 2017 and 30th August 2017.
- Outcomes of a workshop held with the Axe Yacht Club – 6th September 2017.
- Outcomes of a Stakeholder Workshop to identify long-list options held on the 20th September 2017.
- Feedback provided directly to EDDC.
- Work being undertaken by the Environment Agency to determine alternative options in the vicinity of the Axe Yacht Club to reduce flood risk.

The full long-list is presented in Table 2-1.

Table 2-1 Long-list dredging/disposal options

Option Number	Option Description
1	Remove deposited material from the trenches within the spit
2	Deposit dredge material within the spit above Mean High Water Springs
3	Beneficial use – ground raising. Use dredge material to raise ground levels in the Axe Yacht Club Boat Yard.
4	Beneficial use – ground raising. Use dredge material to raise ground levels on the east side of the estuary.
5	Beneficial use – habitat creation
6	Deposit dredge material within spit below Mean High Water Springs
7	Pump dredge material into the estuary on the ebb tide
8	Pump dredged material directly into the sea, using fixed pipes
9	Pump dredged material directly into the sea, using flexible pipes
10	Increase pump diameter to reduce dredging period
11	Pump material onto a dredger and dispose of at sea.
12	Deposit the dredged material into an on-site settlement tank.
13	Deposit the dredged material into a smaller on-site settlement tank/temporary storage, which is then taken away.
14	Reduce the amount of material that settles in the harbour basin by increasing flow rates through it by removing promontory, preventing back eddy into the basin and thus siltation

2.2 Long-List Appraisal

The purpose of the long-list appraisal is to assess viability of each option against its technical suitability (considering coastal processes and build-ability), the impact that it may have on the environment and potential economic viability (as described in more detail in Section 2.2.1 to Section 2.2.3).

The appraisal defines the advantages and disadvantages of each option accordingly and from this it has been determined as to whether the option should be taken through to the short-list.

Where an option may be considered alongside another option, it has been flagged to be included as an '**in-combination**' solution.

Where options may be suitable technically and environmentally but considered to be too expensive for the Axe Yacht Club, they have been flagged for consideration (via a '**sensitivity-test**') in the future when funding may not be a problem / becomes available from other funding sources. Where relevant, these options could be added back into the short-list for further appraisal; these options and the level of appraisal will need to be confirmed with EDDC going forward.

2.2.1 Technical Suitability

Each option has been assessed against the impact that it could have on coastal processes and shoreline interaction, and what the option would entail in terms of the defence functionality of the spit (size / density), available infrastructure and sustainability. This appraisal has been informed by the information and evidence of the coastal processes and shoreline interactions presented in the Coastal Processes Baseline Report (refer to Appendix A) and coastal asset information presented in the Defence Baseline Report (refer to Appendix B).

2.2.2 Environmental Impacts

Each option has been considered against a standard suite of environmental aspects in order to identify key potential impacts. The appraisal identifies, where possible, the positive and negative impacts on different environmental features of different options. It also attempts to indicate relative differences in environmental impacts between options; however, this is not always possible at the high-level of appraisal that this work is undertaken at, and some aspects would only be discernible if more detailed appraisal were undertaken to develop a particular preferred option or options. This appraisal has been informed by the information and evidence presented in the Environmental Baseline Report (refer to Appendix B).

2.2.3 Economic implications

The economic implications are based on a high-level understanding of the likely cost of an option, affordability to the Axe Yacht Club and the likelihood that funding could be sourced from a third-party. However, generic costs for the options were not known/could not be obtained at long-list stage owing to a combination of the uniqueness/complexity of the options.

2.2.4 Marine Management Organisation Consultation Required

Many of the options being explored involve the disposal of dredge material below the Mean High Water Mark, which would require a marine license from the Marine Management Organisation (MMO). Where this is the case, it has been flagged in the long-list.

2.3 Results of the Long-List Appraisal

The results of the long-list appraisal are presented in the following tables:

- The long-list appraisal table, including all supporting evidence, is presented in Appendix D.
- Options filtered out of the appraisal process on grounds of technical, environmental or economic unsuitability are listed in Table 2-2.
- Options short-listed for further appraisal are listed in Table 2-3.

Table 2-2 Options filtered out of the appraisal processes

Option Number	Option Description	Consider in Combination With Other Options	Sensitivity Test - More funding	Summary of Rationale for Discounting from Long-List
4	Beneficial use – ground raising. Use dredge material to raise ground levels on the east side of the estuary.	N	N	The suitability and feasibility of this option is questioned. Not carried forward on this basis.
5	Beneficial use – habitat creation.	N	N	No suitable location for habitat creation at present, either in Axe Estuary or nearby Otter Estuary. Not carried forward on this basis.
10	Increase pump diameter to reduce dredging period.	N	N	This option doesn't address the current issue of disposing dredge material within the spit. Not carried forward on this basis.
12	Deposit the dredged material into an on-site settlement tank.	N	N	No room on site of Axe Yacht Club. Not carried forward on this basis.

Table 2-3 Short-listed for further appraisal

Option Number	Option Description	Consider in Combination With Other Options	Sensitivity Test - More funding	Summary of Rationale for Discounting from Long-List
1	Remove deposited material from the trenches within the spit.	Y	N	Taking through to short-list to consider in more detail.
2	Deposit dredge material within the spit above Mean High Water Springs.	Y	N	This is current practice; however, the Environment Agency would like to explore alternative options. Carried through on the basis that it may be an interim option, with a view for change going forward (i.e. as licensing permits).
3	Beneficial use – ground raising. Use dredge material to raise ground levels in the Axe Yacht Club Boat Yard.	Y	Y	This option is likely to be discounted on the basis of cost and that there is no benefit to the Axe Yacht Club. However, an alternative option to the current disposal of dredged material is required and some possible use beneficially still needs to be considered within the short-list. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the

Option Number	Option Description	Consider in Combination With Other Options	Sensitivity Test - More funding	Summary of Rationale for Discounting from Long-List
				option will need to be considered in combination with other options.
6	Deposit dredge material within spit below Mean High Water Springs.	N	N	Permitting of this option will depend on MMO license. To explore possibility of funding from Environment Agency/third-party source.
7	Pump dredge material into the estuary on the ebb tide.	N	N	Permitting of this option will depend on MMO license. To explore possibility of funding from Environment Agency/third-party source.
8	Pump dredged material directly into the sea, using fixed pipes.	N	N	Permitting of this option will depend on MMO license. To explore possibility of funding from Environment Agency/third-party source.
9	Pump dredged material directly into the sea, using flexible pipes.	N	N	Permitting of this option will depend on MMO license. To explore possibility of funding from Environment Agency/third-party source.
11	Pump material onto a dredger and dispose of at sea.	N	N	Permitting of this option will depend on MMO license. However, if other options such as disposal on the ebb tide, via pipes are favourable, then likely to be discounted.
13	Deposit the dredged material into a smaller on-site settlement tank/temporary storage, which is then taken away.	N	N	A possible option, if funding were to come from Environment Agency/third-party source.
14	Reduce the amount of material that settles in the harbour basin by increasing flow rates through it by removing promontory, preventing back eddy into the basin and thus siltation	N	N	The impacts would need to be considered carefully, and potentially more detailed studies undertaken to better understand the changes that could take place to estuary flows and subsequent deposition.

SECTION 3

3 Short-List Options Appraisal

3.1 Short-List Options Appraisal

The purpose of the short-list appraisal was to assess the viability of the short-listed options in more detail, which required a more vigorous assessment of their technical suitability (considering coastal processes and build-ability), the impact that it may have on the environment, and potential economic viability. For Axmouth Harbour, the short-list options appraisal was completed via a process of consultation, assessment and discussion as shown in the programme of events in Table 3-1, and described in more detail in Section 3.2.

Table 3-1 Programme of consultation, assessment and discussion for Axmouth Harbour short-list options

Short-List Appraisal Activity	2017				2018												2019	
	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02
Long-list options confirmed.																		
Initial MMO consultation on all short-listed options.																		
MMO pre-application.																		
Dredge material and receptor site trial pitting required in support of MMO application.																		
Decision made by EDDC to continue MMO application for option considered to be most suitable (i.e. Option 6: Deposit dredge material within spit below Mean High Water Springs.																		
Opinion from Natural England sought to support MMO application (outside of official MMO application for Option 6).																		
Consultation with Natural England continued via official MMO application process for Option 6.																		
MMO consultation continued on Option 6 (including Environment Agency).																		
MMO consultation on Option 6 underway. Awaiting outcome.																		

3.2 Short List Consultation, Assessment and Discussion

3.2.1 Marine Management Organisation Consultation

Many of the options explored involve the disposal of dredge material below the Mean High Water Mark, therefore requiring a marine license from the MMO. An application was made to the MMO to seek their view/ permission on/to undertake the short-listed options. The application process was started in September 2017, with a number of requirements made by the MMO to supply sediment sampling results and answers to the consultees questions since then; full details are provided in Table 3-2. At the time of writing, a decision on the application is still to be made.

Table 3-2 Details of MMO application/consultation process – September 2017 to February 2019

	Date	From	To	Task
1	20th September 2017	EDDC	MMO	Initial enquiry made with MMO, with details of the short-listed options, to seek their opinion on the options that may either be exempt from an MMO permit or require an MMO license.
2	10th November 2017	MMO	EDDC	MMO responded to EDDC, suggesting a sample of the dredge material should be taken and submitted with an MMO pre-application.
3	November 2017 to March 2018	n/a	n/a	EDDC arranged for sediment sampling of the dredged material to be undertaken.
4	19th March 2018	n/a	n/a	National Laboratory Service provided results of dredged material sampling.
5	28th March 2018	EDCC	MMO	EDDC submitted a pre-application, but MMO provided response saying initial enquiry had timed-out.
6	29th March 2018	EDDC	MMO	EDDC submitted a new enquiry to MMO to seek their opinion on the options that may either be exempt from an MMO permit or require an MMO license.
7	10th April 2018	MMO	EDDC	MMO confirmed that it would be acceptable for the dredge material can be put to beneficial use/utilised in beach re-charge schemes, however, they flagged that the area identified lies within/close to a number of designated sites, MMO requested that further information/data would be required.
8	12th April 2018	EDCC	MMO	EDDC responded to 10th April MMO comments above: • Flagging the lack of clarity on a way forward to agree with MMO an option for disposal of the arisings from the dredging which is licensable. Therefore, a decision was made to progress the most suitable option in the application, determined as being "Option 6: Deposit dredge material within spit below Mean High Water Springs". • Questioning what further information MMO required.
9	12th April 2018	MMO	EDDC	MMO further advised that sediment sampling of the proposed receptor site would be required.
10	April 2018 to June 2018	n/a	n/a	EDDC arranged for sampling of the dredged material to be undertaken.
11	29th June 2018	n/a	n/a	South West Geotechnical provided results of trial-pit investigations.
12	July 2018 to November 2018	n/a	n/a	EDDC/MMO progressed the application for Option 6. As part of the application, MMO consulted Natural England, which merged with ongoing communications between EDDC/Jacobs/Natural England on the short-list options – this is captured in Table 3-3 below and Appendix E.
13	December 2018 to date of this report	n/a	n/a	Ongoing MMO consultation in support of Option 6 application, including Environment Agency. Advise was sought on the impacts of the Option 6 on migratory fish and advise provided accordingly – refer to Table 3-4 below and Appendix G.

3.2.2 Natural England Consultation

In support of the MMO application processes, consultation with Natural England on the short-list of options was undertaken. This fell into two lines of communications, which eventually merged into one;

- Alongside the MMO application, and as part of the BMP process, Natural England were consulted to seek their views on options being proposed for the wider BMP area. Consultation with them on the specific options for Axmouth Harbour began in November.
- As part of the MMO license application process, MMO consult with a number of organisations to seek their views on the works for which a marine license is being sought. Eventually this line of consultation merged with that above around November 2018.

Details and dates of the consultation with Natural England are provided in Table 3-3.

Table 3-3 Details of consultation with Natural England (NE) on short-list of options – November 2017 to February 2019

	Date	From	To	Task	Reference to Further Information
1	23rd November 2017	EDDC	NE	EDDC sought NE inputs on short-list options.	
2	27th November 2017	NE	EDDC	NE advised of role change within their organisation and to seek feedback via the NE consultations inbox.	
3	29th November 21017	EDDC	NE	EDDC sought feedback from NE consultations inbox.	
4	18th December 2017	NE	EDDC	NE provided comment on the short-list of options but requested that further operational detail would be required by them to determine acceptability of the options.	See Table 3-4 below, Columns C & D
5	12th April 2018	EDDC	NE	EDDC queried with NE what operational detail required.	
6	13th April 2018	NE	EDDC	NE responded, advising of organisational change, and that EDDC's query would be passed on within the organisation. However, no response to EDDC provided.	
7	31st July 2018	Jacobs	NE	Jacobs followed up with NE, supplying further operational details (as requested on 18th December 2017) and provided outputs of the of trial pit sampling.	
8	3rd August 2018	NE	Jacobs	NE responded but requesting further detail.	
9	21st August 2018	Jacobs	NE	Jacobs followed up this up, further seeking NE opinion on short-list options.	
10	30th August 2018	NE	Jacobs	NE confirmed that they would look at the options assessment via their discretionary advice service. In support of their discussions, NE would need to better understand the potential effect on the various sites (i.e. Lyme Bay and Torbay SAC and potential Marine Conservation Zone (pMCZ) Axe Estuary pMCZ) depending on the method used.	
11	5th September 2018 to 4th October 2018			To assist NE with their queries and to better understand the impact of the options on the environmentally designated sites in the BMP area,	See Appendix E

	Date	From	To	Task	Reference to Further Information
				supplementary information was prepared by the BMP project team.	
12	4th October 2018	EDDC	NE	EDDC issued supplementary information to NE.	
13	29th October 2018	NE	EDDC	NE responded to the short-list options additional queries.	See Table 3-4, Column E
14	8th November 2018	n/a	n/a	To address the queries raised by NE, a meeting was held with NE.	
15	13th November	EDDC/ Jacobs	NE	Further to the 8th November meeting, additional information was provided to NE options on the 13th November 2018. Some of the key responses are provided in Table 3-4 below. During this period, MMO were also seeking views from NE as part of the MMO application process. NE's views were therefore captured as part of this process as they responded to MMO with their views on the short-list options.	See Table 3-4, Column F

3.3 Results of the Short-List Appraisal

The results of the short-list appraisal are presented in Table 3-4 below. The table captures the key view of the consultees and information provided by the BMP Team in response.

Table 3-4 Short-list options appraisal

A	B	C	D	E	F	G	F	H
Option Number	**Option Description**	**NE Opinion – All options**	**NE Opinion**	**NE Opinion**	**Response/clarifications from BMP Team/EDDC to NE**	**Environment Agency Query**	**Summary**	**Carried Forward**
		18th December 2018		**29th October 2018**	**Approx. 13th November 2018**	**Dec 18 to Jan 19**		
1	Remove deposited material from the trenches within the spit.	Any disposal of dredge material to the sea has the potential to impact on Lyme Bay and Torbay SAC, which is designated for its reef features. These will need to be assessed at the preferred option stage, including consideration of volume, frequency and duration. Timing of the works have the potential to impact migratory fish which are an interest feature of the River Axe SAC/SSSI. This would have to be taken into account when developing a dredge programme.	No further detail provided.				As an option to address disposal of the dredged material, this is not suitable; however, it is noted that should more funds become available, it is a task that EDDC could undertake in the future.	Y
2	Deposit dredge material within the spit above Mean High Water Springs.		No further detail provided.				The Environment Agency are looking to stop this current practice.	N
3	Beneficial use – ground raising. Use dredge material to raise ground levels in the Axe Yacht Club Boat Yard.		No further detail provided.				Review of available information suggests no funds available.	N
6	Deposit dredge material within spit below Mean High Water Springs.		This option has the potential to provide a sustainable solution subject to further detail on volume, frequency and duration. Further operational detail would need to be required to determine acceptability.	We advise this method has the potential to impact on the coarse sediment feature of the pMCZ. The dredged material may form concretions when mixed with other sediments, creating a different sediment type to the pMCZ feature type This would **not** be a preferred option		Advise provided to Environment Agency on impact of Option 6 on migratory fish as part of MMO consultation – refer to Appendix F for full details.	This is the next best solution to existing practices; it makes best use of existing infrastructure and available funds. Works best with natural processes and would be an effective way of disposing of the dredged material.	Y
7	Pump dredge material into the estuary on the ebb tide.		This option has the potential to provide a sustainable solution subject to further detail on volume, frequency and duration. Further operational detail would need to be required to determine acceptability.	We advise further details will be required to ascertain river flow, sediment movement/settlement and coastal process to assess if material released in this way as the tide ebbs, will impact upon the SAC or pMCZ features Subject to this information being provided this option **may** be acceptable	The harbour management company considered the option but discounted it as it not viable. Agitation alone is unlikely to work, the Environment Agency previously carried out a dye test during the operation of the dredger cutter head to ensure there was a minimal resuspension of dredged material into the harbour thereby confirming there was minimal risk of silting up other areas of the Estuary. The inference being that agitating silt to be carried away by an ebb tide is unlikely to be effective. The Harbour Management Company do not feel pumping the arising into the estuary on the ebb tide would be a viable option as when taking into account tide times, daylight hours, working conditions, typical weather conditions and dredger maintenance they feel that there would be insufficient time to dredge the harbour		This is not a feasible for the reasons provided in Column E and therefore not carried forward.	N

A	B	C	D	E	F	G	F	H
Option Number	**Option Description**	**NE Opinion – All options**	**NE Opinion**	**NE Opinion**	**Response/clarifications from BMP Team/EDDC to NE**	**Environment Agency Query**	**Summary**	**Carried Forward**
		18th December 2018		**29th October 2018**	**Approx. 13th November 2018**	**Dec 18 to Jan 19**		
					adequately. At present, the dredging operation just about keeps up with siltation (their last survey shows a slight increase in the volume of silt between December 2017, and February 2018).			
8	Pump dredged material directly into the sea, using fixed pipes.		Disposing of material directly into the sea could have a direct impact to the Lyme Bay and Torbay SAC in the immediate vicinity of the discharge point. Further operational detail would need to be required to determine acceptability.	We advise further information is required to describe method i.e. whether the pipe is to be inserted through the beach material or used from dredge boat. Continual re profiling of beach material may cause weakening of the structure which will make it vulnerable to stormy weather conditions This would **not** be a preferred option	Fixed pipes would not be inserted through the beach, rather laid on top.		Dredge material would not disposed of gradually in the same way as burying it below Mean High Water Springs. This option does not make use of existing infrastructure.	N
9	Pump dredged material directly into the sea, using flexible pipes.		As above.	Further information is required to describe method i.e. whether the pipe is to be inserted through the beach material or used from dredge boat. Continual re profiling of beach material may cause weakening of the structure which will make it vulnerable to stormy weather conditions This would **not** be a preferred option	Flexible pipes would not be inserted through the beach, rather laid on top.		Dredge material is not disposed on gradually. Does not make use of existing infrastructure.	N
11	Pump material onto a dredger and dispose of at sea.		In principal, this option would be acceptable, subject to the identification of a suitable dredge receptor site. A marine licence would be required, and disposal would occur within a licenced disposal site.	Disposal at a licenced disposal site is an option **preferred** by Natural England	The infrastructure is not set-up for this option and would be too costly to undertake this option as the nearest dredge disposal is a long distance away.		The infrastructure is not set-up for this option and funds are not available.	N
13	Deposit the dredged material into a smaller on-site settlement tank/temporary storage, which is then taken away.		No further detail provided.				The infrastructure is not set-up for this option	N
14	Reduce the amount of material that settles in the harbour basin by increasing flow rates through it by removing promontory, preventing back eddy into the basin and thus siltation		No further detail provided.		This option would not provide certainty on capturing the volume of silt that is removed from the harbour. Scour could occur around the structure as flows are redirected, potentially introducing erosion problems elsewhere. Siltation will still occur on an incoming tide. Therefore, this option was considered but is unlikely to work sufficiently with tidal/fluvial flows to prevent siltation in the harbour.		Will not work sufficiently to prevent siltation in the harbour.	N

SECTION 4

4 Preferred Option Selection

4.1 Preferred Options

For Axmouth Harbour, the long-list consisted of 14 options. The long-list of options was then appraised and, via a process of consultation and discussion (as described in Section 3), ratified to a single preferred option. This determined that the preferred option for Axmouth Harbour is: **Option 6: Deposit dredge material within spit below Mean High Water Springs**.

It should be noted that Options 2 and 3, which were flagged to be considered in-combination with other options or in the future should more funds should become available, were not carried forward from the short-list on technical and/or economic grounds.

4.2 Options to Be Carried Forward as BMP Recommendations

In undertaking the options appraisal for the BMP (see Jacobs, 2018b), there are items that could be actioned going forward where possible, such as cliff stabilisation measures, or items that EDDC may wish to consider in more detail. These items would not be achieved via FDGiA but could be funded via maintenance/revenue budgets. Of relevance to Axmouth Harbour is:

• Seaton Spit (seaward face)	54	Remove buried dredged deposits from the spit to increase permeability and enable it to better dissipate wave energy

SECTION 5

5 References

Jacobs, 2018a. Seaton Beach Management Plan. Report and Appendices Prepared by Jacobs for East Devon District Council, February 2018.

Jacobs, 2018b. Seaton Beach Management Plan. Options Appraisal Report. Prepared by Jacobs for East Devon District Council, February 2018.

Appendix A – Coastal Processes Baseline Report

Appendix B – Environmental Baseline Report

Appendix C – Defence Baseline Report

Appendix D – Long-List Appraisal Table

Appendix D – Long-List Appraisal Table is provided on the accompanying CD.

Appendix E – Supplementary Information on the Impact of Short-List Options on Environmentally Designated Sites

Appendix F – Supplementary Information on the Impact of Preferred Option on Migratory Fish

6 Risk of Suspended Solid Plumes Affecting Upstream Fish Migration into the River Axe

6.1 Assumptions

- Removal of fine material using a suction method
- Material is pumped over the spit
- Material deposited into a trench formed below Mean High Water Springs, but above Mean Low Water Springs
- Material only pumped into the trench during low tide
- Trench back filled prior to turn of the tide
- Trench located as far west as possible (i.e. away from the mouth of the estuary)
- Works only occur between December - March
- Response in relation to Atlantic salmon, sea trout and sea lamprey only

6.2 Technical View

There is concern that dredged material will be released from the dredge deposit trench as a consequence of tidal inundation and wind/wave action. The concern is that the released material will result in elevated suspended solids concentrations on the seaward side of the spit that would prevent or delay fish from migrating into the Axe estuary- any delay potentially risking spawning success. Fish receptors of concern are thought to be Atlantic salmon, sea trout and sea lamprey, all of which migrate as adults into freshwater systems to spawn. Sea lamprey generally migrate into freshwater systems in the spring and early summer months; sea trout begin to migrate into freshwater systems in the spring, with most generally migrating between summer and early autumn (June to October); and, salmon migration is variable, and runs can extend from spring into late autumn. The proposed Axmouth work schedule has the potential to overlap with the upstream migration of early running sea lamprey, salmon and sea trout, although the extent of the overlap is likely to be limited due to the bulk of the works being completed in the early months of the proposed schedule.

It is considered that material will be lost/released from the deposit trench gradually, and highly unlikely that substantial suspended solids plumes would arise during periods of average wind/wave/tide. It is possible that during periods of higher wind/wave energy elevated suspended solids could be released from the deposit trench, although the depth and backfill capping of the trench should limit the potential for the large plumes of material to be released into the water column.

It is likely that these levels would be within the natural baseline encountered along the coast during normal storm periods, and thus something which sea lamprey, salmon and sea trout are well adapted to coping with. Both salmon and sea trout are capable of tolerating periods of elevated suspended solids loading, which they often encounter during the winter months when they are in freshwater catchments. In addition, both salmon and sea trout are very strong swimmers, and are able to actively avoid / swim through areas of poor water quality should they choose to. It should also be noted that natural coastal dynamics are likely to carry any released suspended solids away from the area therefore there will not be a prolonged area of increased suspended solids loading. As such, any resulting plumes of elevated suspended solids are unlikely to prevent or delay the upstream migration of the species of concern, hence potential effects on fish related to the release/re-suspension of deposited dredge material are predicted to be negligible.