

Item: 13

Development and Infrastructure Committee: 2 April 2019.

Churchill Barriers - Wave Overtopping and Tidal Energy Capture.

Report by Executive Director of Development and Infrastructure.

1. Purpose of Report

To review historic activity in respect of wave overtopping and tidal energy scheme concession for the Churchill Barriers and consider the next steps.

2. Recommendations

The Committee is invited to note:

2.1.

That, in December 2014, the Committee noted the lowest cost option for a solution to wave overtopping solution only at Barrier Number 2, at an estimated cost of £13 million, being to reface the east side of the barrier.

2.2.

That, in December 2014, Council agreed to investigate developer interest in progressing a wave overtopping and tidal energy scheme at Barrier Number 2.

2.3.

The progress made in respect of a tidal energy scheme at Barrier Number 2, as detailed in section 4 of this report, with the proposal that no further work is undertaken on this.

2.4.

That, between 2006 and 2018, the average number of closures per year due to bad weather has been seven, with each closure having an average duration of 3 hours 40 minutes and 33% of closures due to wind from the west, as detailed in section 5 of this report.

2.5.

That, in February 2016, a caisson was placed on the east side of Barrier Number 2, for which a Marine Licence was required, with this due to expire in June 2019.

2.6.

The results of investigations into historic sedimentation trends, as detailed in section 6 of this report.

2.7.

Options for wave overtopping at Barrier Number 2, as outlined in section 10 of this report, with the preferred option being Option 3, namely to commission a study to further assess the viability and cost of beach recharge at an estimated cost of £60,000.

It is recommended:

2.8.

That no further action be taken in respect of a tidal energy scheme at Barrier Number 2.

2.9.

That the Executive Director of Development and Infrastructure should submit a report, to the next meeting of the Policy and Resources Committee, identifying funding options to commission the study at Barrier Number 2 referred to at paragraph 2.7 above.

2.10.

That the Executive Director of Development and Infrastructure should apply to Marine Scotland for an extension of the marine licence to allow the caisson to remain in position until an alternative use is found for it.

3. Background

3.1.

Work has been underway since 2009 to investigate matters associated with wave overtopping at Barrier Number 2. This included a survey of the seabed at the barrier, which was undertaken during the summer of 2009, following which a consultant, Mott MacDonald, was appointed to determine the extent of the wave overtopping at Barrier Number 2 and review possible solutions. In March 2011, the consultant presented a final report recommending options for further development and analysis which included more detailed hydraulic modelling, including a physical modelling study, to ensure a reliable evidence base is available to base any future project proposals and funding considerations. Options rejected at this stage included extending the wave wall and use of block ships.

3.2.

In December 2011, the Council agreed to carry out a detailed hydraulic modelling study to find a solution to the wave overtopping at Barrier Number 2. Following initial approaches from developers and others interested in promoting energy capture from tidal turbines installed in the Barriers, the scope was widened to investigate both a solution to the Barrier Number 2 wave overtopping problem and the possibility of tidal energy capture from both Barriers Number 1 and 2.

3.3.

In June 2014, the consultant, JBA, presented their study, which considered four main options to reduce wave overtopping as follows:

<i>Option Series</i>	<i>Option</i>	<i>Sub-option</i>	<i>Estimated Cost(£)</i>
1 - Reface Barrier (rock armour)	1A	High Crest	16,500,000
1 - Reface Barrier (rock armour)	1A	Low Crest	18,000,000
1 - Reface Barrier (concrete block)	1B	High Crest	23,000,000
1 - Reface Barrier (concrete block)	1B	Low Crest	25,000,000
1 - Reface Barrier (Xbloc)	1C	High Crest	17,000,000
2.1 - Nearshore Breakwater (rock armour)	2.1A	-	30,000,000
2.1 - Nearshore Breakwater (concrete block)	2.1B	-	47,000,000
2.1 - Nearshore Breakwater (Xbloc)	2.1C	-	22,000,000
2.2 - Offshore Breakwater (concrete block)	2.2B	-	81,000,000
2.2 - Offshore Breakwater (Xbloc)	2.2C	-	60,000,000
3 – Bridge	3	-	23,000,000
4- Beach Recharge	4	-	17,000,000

3.4.

In December 2014, after being advised by consultant JBA that an optimised design for refacing the east side of Barrier Number 2 had an estimated cost of £13m, the Council agreed to investigate developer interest in progressing a wave overtopping and tidal energy scheme at Barrier Number 2.

4. Tidal Energy Concession

4.1.

In March 2016, the Council agreed to publish a Concession Notice in the Official Journal of the European Union (OJEU), inviting potential developers to prequalify for a tidal energy concession for Churchill Barriers Nos 1 and 2. A concession contract would allow a developer to use the Barriers for a tidal energy scheme. The developer would be responsible for the design, construction, operation and financing of the scheme.

4.2.

The Concession Notice was published on 18 August 2016. Eight responses were received by the return date of 12 October 2016. Following evaluation, two consortia were deemed to have submitted full and compliant information which met the minimum requirements to participate.

4.3.

On 10 April 2017 one of the consortia advised they were no longer interested in pursuing the concession contract. The remaining consortia were advised that they were

the only interested party and were invited to submit their preliminary proposal. No proposal was forthcoming from the remaining consortia, and after providing them with notice, they were advised that the OJEU procurement process was closed on 6 March 2018.

4.4.

The business case for a tidal energy scheme has always been marginal at best and given the current lack of support for tidal generation, this is unlikely to change in the short term. The Council has had contact with the Brouwersdam Tidal Project in the Netherlands and the Swansea Tidal Barrage and neither of these projects are proceeding at present. On the basis that the Council has undertaken a lengthy and comprehensive process to explore the feasibility of tidal energy capture solutions and that this work has not identified a viable solution, it is proposed that no further work is undertaken on this.

5. Closures

5.1.

The average number of closures per year between 2006 and 2018 has been seven, with each closure having an average duration of 3 hours and 40 minutes. The longest recorded closure since 2006 is 10 hours on 7 December 2017 due to wind from the west. A record of barrier closures from 2003 to 2018 is given below.

<i>Year</i>	<i>Number of closures EAST</i>	<i>Duration of closures (hours) EAST</i>	<i>Number of closures WEST</i>	<i>Duration of closures (hours) WEST</i>
2018	7	28	1	3
2017	2	6	3	20
2016	3	10	1	1
2015	4	27	3	19
2014	14	39	2	5
2013	3	8	3	11
2012	4	12	2	10
2011	4	13	7	19
2010	7	31	1	2
2009	4	10	0	0
2008	1	4	4	13
2007	3	8	3	13
2006	4	17	0	0
2005*	4	27	-	-
2004*	2	6	-	-
2003*	2	4	-	-
Total 2006 to 2018	60	213 Hrs.	30	116 Hrs.

*Direction of closures not recorded before 2006

5.2.

It is significant to note that 33% of all closures in the period 2006 to 2018 were due to winds from the west. Any solution that focused only on the east including offshore breakwaters, refacing to the east only and beach recharge, would not prevent the closures due to westerly winds. The only solution proposed that would be effective for both sides is a bridge which has been costed at £23 million.

5.3.

For comparison, in 2017, the North Isles (Westray, Sanday, Eday and Stronsay) lost 37 sailings due to weather, equivalent to approximately 144 hours (six days) with no boat. The figures for 2018 were 53 sailings, which is equivalent to approximately 216 hours (nine days).

6. Beach Recharge

6.1.

In March 2016, an investigation undertaken by consultants, JBA, into historic sedimentation trends suggested that approximately 50% of the sand required to form a beach to the east of Barrier Number 2 had been deposited, with depths of sand up to 6 metres in the deepest part of the channel. Although recent trends were inconclusive, a simple projection would suggest that it could take another 70 years before a beach was formed similar to that which has occurred at Barrier Number 4. Based on the study, it was proposed to further investigate a beach recharge solution to see if the cost estimate could be reduced. The cost of that study was estimated at £26,200, however, the Council decided not to proceed with a further study at that time and instead proceed with a tidal energy concession.

6.2.

As a tidal energy solution has not been forthcoming there is now the option to proceed with a study to investigate a lower cost beach recharge solution. To inform the study a full hydrographic survey of the wider area and bottom sampling to establish sand deposits would be required. The cost of this work is estimated to be £60,000.

6.3.

A beach recharge solution would have a number of advantages:

- The existing Barrier Number 2 structure would be retained.
- There would be no visual change from the west.
- A long term possibility to move the road to the east providing protection from the west.

7. Low Cost Solutions

There have been a number of approaches to the Council in recent years with ideas from interested parties for other solutions to wave overtopping which could be “lower cost”. In general, these fall into categories as variants of the solutions investigated in

the Council study but without detail or costs. Details of the proposals are provided in Appendix 1 to this report.

8. Caisson

8.1.

In February 2016, a second-hand caisson was purchased and placed on the east side of Barrier Number 2. The location for the placement of the caisson was identified following consultation with local Community Council representatives. Due to its small size, the caisson was not expected to have any significant effect in reducing wave heights or preventing barrier closures. This has turned out to be the case. Observation during closure conditions from the east show the caisson having little effect on the waves. Installation of a CCTV camera to monitor the caisson was considered but decided to be poor value as it would not contribute any useful information.

8.2.

The temporary Marine Licence for the caisson issued by Marine Scotland expired on 8 June 2017 and was extended until 19 June 2019. The terms of the licence require that the caisson be removed on expiry of the licence. The intention is for the caisson to be used for another purpose however to date no other use has been identified. It is not yet known how Marine Scotland would react to a further extension request for the licence. Prior to removal, a hydrographic survey will be required to determine the extent of dredging required to allow the caisson to be floated out.

8.3.

The estimated cost for the hydrographic survey, dredging and removal of the caisson is £60,000 which can be met from amounts set aside in the Renewable Energy, Redevelopment and Regeneration Fund.

9. Flood Risk Management

9.1.

Reducing coastal flood risk to Barrier Number 2 is a priority action in the Orkney Flood Risk Management Plan. However, it only ranks number 163 in the Scottish national list of priorities and is unlikely to receive funding at present. A reason for the low ranking is the low level of annual damages resulting from flood risk, presently estimated as £37,000 in annual maintenance costs. It is noted that information on the economic consequences of road closures is difficult to estimate. Without a significant change to the damages figure or different criteria being applied it is difficult to see the national ranking improving.

9.2.

The Scottish Environment Protection Agency launched a new Coastal Flood Warning Scheme for Orkney on 18 September 2018. This includes forecasts for the barriers which improves the amount of advance notice of conditions likely to cause barrier closures.

10. Options

The following next step options could now be progressed:

10.1.

Option 1: Develop a project to reface the east side of Barrier Number 2, at an estimated cost of £13 million, through the Capital Project Appraisal process. When complete this would reduce closures of the Barriers by around 60%.

10.2.

Option 2: Develop a project to progress with a bridge to replace Barrier Number 2, at an estimated cost of £24.5 million, through the Capital Project Appraisal process. When complete this would eliminate closure in all but the most extreme conditions.

10.3.

Option 3: Progress a study, at an estimated cost of £60,000, to further assess the viability and cost of a beach recharge option.

10.4.

Option 4: Remove the caisson and take no further action in relation to overtopping at Barrier Number 2.

10.5.

For options 1 to 3 above, the Council could apply to Marine Scotland for an extension of the marine licence to allow the caisson to remain in position on the grounds that it could have a role in a future project.

10.6.

Option 3 is recommended as the most cost effective option at this stage for further consideration, in line with the Council Plan priority to explore future solutions to the barriers.

11. Links to Council Plan

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Council Plan strategic priority of Connected Communities.

12. Links to Local Outcomes Improvement Plan

The proposals in this report support and contribute to improved outcomes for communities as outlined in the Local Outcomes Improvement Plan priority of Strong Communities.

13. Financial Implications

13.1.

The sum of £325,000 was initially set aside in financial year 2012 to 2013 to allow a Barriers feasibility study to be progressed. An additional funding commitment of up to £38,800 was further approved in 2016 to progress a concession contract for a tidal energy scheme at Churchill Barriers Numbers 1 and 2. The latter funds were duly set aside from within the Renewable Energy, Redevelopment and Regeneration Fund but subsequently were not required.

13.2.

As at 4 February 2019, the total cost of undertaking these studies amounts to £306,506.23 leaving an available balance of £18,493.77.

13.3.

A caisson was initially purchased in December 2015 through the Council's capital programme at a cost of £45,000. The installation of the caisson at Barrier Number 2 cost £90,137.99 against an estimate of up to £132,000 and was funded from the Renewable Energy, Redevelopment and Regeneration Fund.

13.4.

The report identifies two options to develop capital projects, which if supported, would require to be progressed through the Council's capital project appraisal process. In giving due consideration to levels of capital investment required, the associated revenue implications also need to be considered. Whilst the affordability of the Council's capital programme can be heavily influenced by factors such as how the capital works are to be funded, as well as the ability of Services to meet any associated loan charges, perhaps more immediate would be the need to first quantify and then confirm how the cost of developing the capital project appraisal itself is to be met.

13.5.

The preferred Option 3 to progress an initial feasibility study is not directly comparable with options 1 and 2. The proposal to further assess the viability and cost of a beach recharge as an option, is potentially a pre-cursor to developing a capital project in the future, and has been estimated at a cost of £60,000 as follows:

	£	£
Study	30,000	
Hydrographic survey	10,000	
Bed sampling	10,000	
Apportioned costs	10,000	
Total		60,000

On the basis that this option is not affordable from the remaining balance of feasibility study funds, as identified at section 13.2 above, then it may be appropriate for the Service Committee to make a spending recommendation to the Policy and Resources Committee.

13.6.

Similarly, option 4 simply identifies the cost of removing the caisson and tow it to a storage location at Lyness as £60,000. This could be met from the allocation of up to £87,000 previously set aside within the Renewable Energy, Redevelopment and Regeneration Fund for further licences, modelling, relocation and final removal of the caisson.

14. Legal Aspects

14.1.

Although the Council owns the footprint of the Barriers, any additional sea bed required for a development would need to be leased from the Crown Estate subject to availability of prospective areas of the sea bed.

14.2.

The project would be subject to obtaining any necessary planning consents, an Environmental Impact Assessment and the granting or extending of any necessary marine licences. A works licence may also be required in terms of the Orkney County Council Act 1974. The Council would be required to adhere to the conditions of any such consent or licence.

14.3.

A marine licence will be required to allow the caisson to remain in place after 19 June 2019.

14.4.

The Council must make arrangements which secure best value. Any further studies would be subject to the Council's financial and procurement procedures.

15. Contact Officers

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16. Appendix

Appendix 1: Barrier Number 2 Wave Overtopping – Proposals Received.

Barrier No.2 Wave Overtopping - proposals received

The following proposals for a solution to the wave overtopping problem at Barrier No 2 have been received from individuals or companies over the past few years.

Artificial Reef

A proposal was received for an artificial reef on 27 November 2014.

The reef would be several hundred yards offshore and would protrude above the surface at high tide. It would be constructed from high density rock with random sizes in the range 15 to 25 tonnes. The proposal notes that local rock would be unsuitable and proposes rock sourced from Norway or Iceland.

No details or costs have been provided for the proposal.

The proposal is similar to the proposals in the JBA Report for offshore and nearshore breakwaters which were estimated at £30m for the near shore rock armoured solution and £20m for the lowest priced nearshore concrete xblock option.

Culvert Option

A proposal was received for a culvert option in November 2014.

The proposal involves raising the road level 2.5m by placing precast concrete culvert units on top of the existing carriageway. A concrete deck and new road surface would be provided on top of the culvert units. The principle is that breaking waves and debris would pass through the culverts under the carriageway so protecting traffic.

An outline proposal has been provided along with a cost estimate of £5.3m which excludes fees and contingencies.

This is an original proposal and there would be a number of issues to be considered:

Would it provide sufficient protection?

Would it be aesthetically acceptable?

Would it be structurally sound?

Could it be safely constructed while maintaining traffic flows?

Bridge Option

A proposal was received for a bridge option in December 2014.

The proposal involves constructing a bridge based on the design of the Hatston Pier Extension. It is noted that the Hatston Pier Extension cost around £8m. This would allow partial removal of the Barrier in the future to facilitate tidal generation.

This is one of the options considered in the JBA report which estimated a bridge solution at between £14m and £23m.

Rock Fill Option

A proposal was received for a rock fill option.

The proposal involves creating a 250m long by 30m wide rock bank in front of the north east face of the Barrier up to the still high water mark. The stone would be obtained from the Lamb Holm quarry with the larger blocks of stone won being used for rock armour.

No cost estimate has been provided.

The proposal can be considered as a cross between two of the options in the JBA report namely the refacing option estimated at £13.5m and the beach recharge option estimated at £17m.

Issues to be considered:

The risk of founding the rock fill on sand.

It is likely suitable rock armour would have to be imported.

13 June 2016