

Barmouth North OBC Review – Note these figures are updated by Appendix R which discussed phasing of the works see Section 2 of this review

Gwynedd have provided a response to Welsh Government Comments in a Separate notes. These responses are reviewed in Section 3 of this report.

Local Authority	Gwynedd County Council
Project Name	Barmouth North
Type of Report	OBC
Estimated Detailed Design Cost (£k)	£969k
Estimated Construction Cost with Optimism Bias (£k)	£23,238k (include ~£5m risk and ~£5m OB)
Optimism Bias (£k) (%)	26% (design and construction) 60% maintenance
Standard of Protection	1 in 50 in 2069 (>1 in 200 present day)
Number of Properties Protected	447 properties benefitting from scheme (390 residential/57 non-residential)
Benefit Cost Ratio	1 : 2.3
Wider Benefits	Protecting a stretch of the Cambrian Coastal Railway.
Proposed year for construction	2022
Potential Partners	██████████
Other Issues	Approval is requested for works to 2069 only, after this point the scheme reverts to Managed Realignment. The cost benefit ratio is based on the whole scheme. Gwynedd are currently proposing to split initial the works into 2 phases, structural works and beach nourishment works
Location	52.731262, -4.068191

Received Date	13/07/2021
Review Completed Date	04/11/2021
Approved	Yes
Name of Reviewer	██████████

The Barmouth North OBC was originally submitted in August 2019 and presented to Welsh Government in January 2020. Key points from that meeting were:

- To review the affordability of the scheme (in particular GCCs match funding), including investigating a contribution from ██████████
- Review required of the requirements of the SMP2 policy which suggests Managed Realignment from epoch 2.

The OBC was recalled by GCC for internal review due to funding concerns.

1. Introduction and Figures

The town of Barmouth lies behind a long sandy and fine-shingle beach in Cardigan Bay. The promenade is a valued asset, providing access to the blue flag beach. The seafront provides the local

population with leisure and recreational amenity. Tourism is important to the local economy; the small town attracts around 280,000 visitors annually.

The 1.2km study area comprises a mix of hard coastal defences (sheet piled wall, concrete revetment and wave recurve wall, with masonry setback walls). The defences run parallel with the promenade and adjacent Marine Parade.



Figure 6. Study extents and key features of note within Barmouth



2. Purpose

This OBC seeks approval for the detailed design and consenting of essential works for the vulnerable North Barmouth promenade.

3. Strategic Case

A. Strategic Fit

The Strategic Case is well defined and makes reference to relevant local and national policy and legislation. The Wellbeing of Future Generations Act is referenced but minimal assessment has been made as to the impact this project will have on Well Being Goals in this section, Well Being goals have been referenced throughout the report.

Of particular note is the The West of Wales Shoreline Management Plan 2 (SMP2) (2011) sets out the coastal management policy. In the short-term (Epoch 1 Year 0-20), the frontage is to continue to 'hold the line'. However, due to implications of climate change, the present alignment was considered '*likely to become increasingly difficult to sustain*'. Therefore for the medium and long term the SMP2 sets out a change in approach to 'managed realignment'.

The SMP2 notes; '*consideration should be given to widening the overall defence system in this area. This may require nearshore or shore connected structures to reduce wave energy but is also likely to require some future realignment of the defences, quite probably with the loss of property. This would require a more integrated approach to management, considering how the northern seafront could be developed to better advantage both in term of use and shoreline management.*' Adjacent policy areas (i.e. Llanaber and Barmouth South) are 'Hold the Line'. All three are intrinsically linked - forming a single flood-cell with interacting coastal processes.

Pen Llyn a'r Sarnau SAC is approximately 171m south-west from the site, and runs adjacent to the length of the promenade. SACs are strictly protected environmental sites designated under the EC Habitats Directive, any works which impact on or are within these extents will be subject to considerable consultation and approval with NRW and wider authorities.

Rivers (e.g. the two ordinary watercourses outfalls in the frontage) are a Welsh Priority Habitat and River Corridors have a Gwynedd council Biodiversity Habitat Action Plan. Proposals which involve works within the channel of the watercourse, could result in temporary disturbance of this habitat type and potential pollution both within or beyond the boundaries of the site. The sand dune system at South Barmouth is also a priority habitat and a Gwynedd Biodiversity Habitat Action Plan, works within North Barmouth will need to consider wider the impacts on this neighbouring habitat.

Several important local species require consideration during the schemes development including: otters (due to presence of ordinary watercourses), wolverines (unlikely to be present), bats (habitats in culverts) and nesting birds (within the sand-dune system – particular care is required during bird nesting season – April-August). As such, specific considerations to activities around the watercourses, the beach environment (along the full frontage) and trees should be made.

B. The Case For Change

Barmouth's sea defences originally reportedly date from the 1900-1920s. Further improvements in 1930s included timber groynes and a concrete revetment. A sheet pile toe was added in 1956 due to scouring and lowering of beach levels. The concrete wave recurve wall was added between 1972 and 1974, with refurbishment of the timber groynes and shingle beach nourishment. Inland, there is a 'defacto' flood wall situated on the landward side of Marine Parade. This wall has demountable stop logs across access points to help contain overtopping.

The existing defences are in a poor condition. Should beach drawdown continue, then structural failure is increasingly a concern. Part of the promenade failed due to unsafe voiding beneath the promenade slab, requiring emergency stabilising repairs in 2020 and 2021. The repair works were emergency measures to extend the life of the existing structures until the preferred option is implemented.

Beach levels decrease and defences deteriorate in condition towards the north of the study area. Studies conclude that overall foreshore bed levels along North Promenade are lowering and this lowering is expected to continue.

The study area is at risk of coastal flooding. Overtopping occurs at the northern end of the promenade in 'benign' conditions i.e. median level tides, without surge, swell, low pressure or high winds.

Most notably, were the January 2014 storms, where significant volumes of water overtopped the coastal defences (as highlighted in Figure 16 and Figure 17). The NRW Flood Investigation Report (2014) noted significant damage along a large stretch of the coastline including both North and South Barmouth, in particular the Promenade Café and Barmouth Harbour where residents had to be evacuated

The study area is also at risk from the tide-locking of two ordinary watercourse outfalls, and blockage/capacity of culverts. Flap valves on the outfalls have also failed, risking tidal ingress. In the absence of investment, 757 properties are predicted to have more than a 1 in 100 chance of flooding in any year. 300 properties are currently at risk from a present day 1 in 10.

The Coastal Process Assessment (2019) indicates that there is not a strong transport regime along the frontage. Whilst to the north, there was a general lowering of foreshore levels between 2006 and 2014, although changes remained limited at the north-most end of the frontage. Extensive lowering occurred offshore (40-140m) in 2013 and 2014.

Future beach evolution is difficult to predict but assuming No Active Intervention (NAI), erosion is predicted by the SMP2 to continue at North Promenade totalling between 30m and 120m over the appraisal period. Based on the average SMP2 lateral erosion rates over a 100 year period, beach levels could decrease by up to 0.7m for northern study extents.

By 2069 mean sea levels are predicted to have increased by 0.42m and by 2119 by 1.1m.

The existing defences have a number of structural.

- At the northern end of the promenade, the corner wall appears to be undermined, with significant fill material loss beneath the promenade slab.
- Toe sheet piles at the northernmost 200m are exposed with evidence of section loss and severe abrasion of the concrete encasement.
- A residual life of less than 10 years is reasonable to assume.

The condition of the northern area of the North Promenade deteriorated during extensive overtopping during March 2020. Voiding and material loss behind the sea defences led to a collapse. 30m of new sheet pile wall were installed in front of the existing sheet pile toe and concrete was poured in between the new and the existing sheet pile toe. Voids of up to 1.5m to 2.0m depth were filled. The repair works were emergency measures are short-term (design life <10 years) and aim to extend the life of the existing structures until the main scheme takes place.

C. Business Need

Five investment objective have been set, these are SMART and considered appropriate for this type of project.

- To reduce the threat of coastal flood and erosion risk to people and property with due consideration of SMP2 policy to ensure the long-term resilience and vitality of the community.
- To support, and where possible enhance, recreation and amenity value of the local area
- To maintain, and where possible enhance, natural and historic environments.
- To ensure marine amenity activities can continue to grow.
- Ensure an affordable and deliverable whole life option through a partnership approach and contributions.

Critical Success Factors have also been set, these have been linked to the 5 business case model. These are considered relevant, appropriate and well defined.

D. Benefits

A review of benefits and wider benefits has been completed. A benefits map is included in Appendix K.

- Health and Well-Being: Beaches and promenades can play an important part in facilitating physical activity. Intangible health benefits reflect the longer term personal impact of flooding on the health and wellbeing of those affected.
- Construction and employment: During construction the scheme is likely to generate approximately 13.3 jobs per £1million spend. Training and apprenticeships will help to make sure that young people living in Barmouth and indeed other parts of Gwynedd are able to benefit directly from the scheme. Local procurement where possible will help to ensure that wider supply chain benefits are remain within North Wales where possible and help to support local businesses.
- Amenity and Recreational Value: Tourism is a major component of the local economy, a scheme would look to safeguard the wider town and provide opportunities for improving the promenade and access to the beach.

E. Risks

Strategic and project risk have been summarised along with mitigation actions. Key project specific risks include:

- Impact on neighbouring SMP Policy Units and the future change of SMP policy to Manage Realignment.
- Failure to identify match funding
- Impacts on the railway line and working in close proximity to the line.
- Sensitive engagement required around the Heol-Y-Plas housing estate.
- The nearshore Pen Llyn a'r Sarnau Special Area of Conservation (SAC).
- Significant damage to the defences prior to scheme completion.
- Unknown construction details of current defence.

4. Economic Case

A. Available Options

A Longlist of nine options (and sub-options) were identified and then screened against the investment objectives, CSFs and Options Framework Filter and criteria of: constructability, cost & performance, environmental impact and applicability. This resulted in 3 Do Something Options. The approach used to establish review and shortlist options is considered reasonable and utilised best practice as set out in the WG Business Case Guidance. This was done in an open and collaborative manner.

Only one baseline scenario is included in the main report but both are covered in the Economic assessment appendix.

Walkaway It is expected there will be a continued reduction in beach levels over the next 10 year period, particularly. There is a slight southerly near-shore drift of material, however this is very limited. It is noted that the winter storms of 2013/2014 caused a rapid reduction in beach levels. Future storms are expected to exacerbate beach levels significantly. With on-going beach drawdown, the global stability of the structure from sheet pile toe exposure increasingly becomes a concern. As such, the residual life of the sea-wall and revetment is considered to be <10 years.

Business As Usual This scenario considers the continuation of the present beach management regime, with repairs to the existing defences as they become necessary (i.e. continuation of the 'status-quo') at an on-going cost to YGC. The present structure maintenance and beach management regime involves an 'as and when' programme of inspection and maintenance – including:

- Filling of voids, sealing of joints and mortar replacement along the promenade.
- Repairs to the secondary and tertiary flood defence walls following storm events.
- Maintenance of deployable flood barriers..

Measures to protect or replace the sheet pile section and arrest the abrasion/ corrosion are likely to be significant and are **not** considered a Business As Usual intervention. Continued loss of the structural section means there is an expected residual life of <20 years. Without this work it is assumed that the Business as Usual option shares the same risk and the same failure mode as the Walkway Option. Due to the similarity between the baseline Walkaway and Business As Usual Scenarios, the modelling and economic assessment approach taken has been, **conservatively**, to consider the Business As Usual as the baseline going forwards, whilst testing sensitivity to features of the Walkaway scenario including not operating the flood boards, no measures taken to manage local flooding, and additional breached in the primary wall.

Option 2. Betterment of existing defences - Crest-raising restricted to 1.25m Standard of Protection (SOP) of up to 1in50 in 2069.

Works to address defects and extend the service of the existing defences. Improvements to defences:

- Extend the life of the existing sheet piles with refurbishment works.
- Raise the primary defences and add protection to the structure toe by a rock-toe or shingle beach profile (where material stability allows).
- Strengthen and raise the set-back flood wall.
- Improve demountable barriers and drainage.
- Public-realm improvements including provision of dwell areas, beach access and connectivity to the wider community.

With no strong material transport regime along the frontage, there appears limited case to repair the groynes and beach access could be improved.

The crest of the defences is presently 5.8mAOD. Visual amenity constraints mean the primary defences can be raised by 450mm to a crest level of 6.25mAOD (1.25m in height). This would reduce overtopping to <200l/s/m for all 1in200 year events up to 2069,

Option 3. Beach Management and Associated Structures - SOP up to 1in200 year in 2119.

Combination of rock breakwaters offshore and/or shore-linked groynes (rocks or refurbish existing) to hold placed beach material and dissipate wave energy. Coarser shingle beach recharge material introduced to provide sustainable beach level to protect the primary defences and reduce wave overtopping. Works to extend the life of the existing sheet piles required.

The minimal beach profile for a nourished beach is a beach crest height of 6mAOD (2019) to 7.1mAOD (2119) and a crest width of 15m. Although sediment losses are not considered to be significant, allowances for beach loss should form part of the on-going maintenance.

Option 4. New line of defence set back at the railway (i.e. Managed Realignment) - SOP up to 1in200 year in 2119.

New line of defence setback whilst protecting railway, allowing the area directly behind the existing sea-wall to be subject to erosion with:

- **Option 4a.** Set back along promenade full length
- **Option 4b.** Set back along northern end of promenade with *(Beach management (similar to Option 3) protecting properties to south)*.

The SOP achieved is expected to be defined by the new line of defence. It is envisioned a SOP of 1 in 200year + CC to 2119 would be achievable. Groynes are likely to be required to afford protection to the neighbouring policy units.

Each of the shortlisted options were assessed against the Engineering performance, Sustainability and well-being performance, their Economic performance and their Financial performance.

Economic Performance

Three epochs were modelled 2019, 2069 and 2119. A range of SOPs (1 in 50, 1 in 100 and 1 in 200 for 2019 and 2069) were modelled.

The baseline scenario was modelled Business As Usual as the 'Baseline' Scenario and sensitivity testing of the Walkaway scenario. Prediction sensitivity to breaches in walls was tested and demonstrated. For the modelled 'Baseline' Scenario, the primary wall is assumed to remain in-situ; a conservative approach.

Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) reduces the implication of this limitation on the business case.

Flood Damages

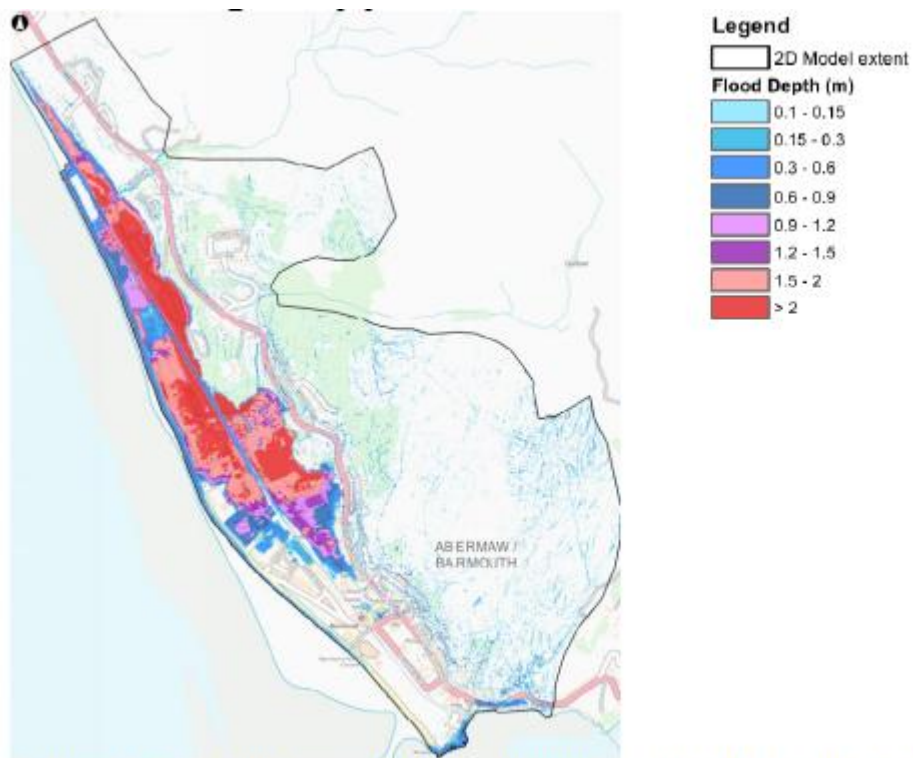


Figure 24. Baseline Flood Depths (2019) Combined 1 in 200 year event

Table 28. Baseline (assuming no breach) property count for the epochs including climate change¹⁹

	NCC (Present day, no climate change (CC))						CC2069						CC2119					
Return Period	1	10	50	100	200	1000	1	10	50	100	200	1000	1	10	50	100	200	1000
Baseline	14	300	322	757	760	761	261	>261	>538	>757	>760	>761	>261	>261	>538	>757	>760	>761

Erosion Damages



Figure 25. Potential erosion over 50 year period based on SMP2 NAI scenario



Figure 26. Potential erosion over 100 year period based on SMP2 NAI scenario

Continued erosion of the frontage causing recession of the shoreline and:

- Loss of properties due to erosion: There are up to 60 properties within the anticipated erosion band over the next 100 years. Most of the properties affected are residential.
- Cambrian Coast Railway: Provides a strategic public transport link to coastal towns in west Wales, including Barmouth. Disruptions to this asset would have heavy economic and social implications to the wider county of Gwynedd. Loss of railway service beyond Barmouth would affect 17 stations.
- Loss of recreational value of Barmouth North Promenade
- Damages to highways and utilities infrastructure: Two non-main river outfalls (and pumping station) are likely to require replacement once they have failed.

Table 4. Summary of shortlist option costs

	Option 2	Option 3	Option 4a	Option 4b	Notes - assumptions, source(s) and dates
OBC to construction (£k):					
Subtotal	£899	£2,516	£8,029	£5,983	30% Optimism Bias applied to 'OBC to Construction'
Construction (£k):					
Subtotal	£16,055	£56,492	£47,257	£31,539	60% Optimism Bias applied – applied to 'Construction' costs due to uncertainty pending further survey and design.
Future costs (scheme implemented at Year 0):					
Subtotal	£62	£2,864	£72	£72	60% Optimism Bias applied – due to uncertainty regarding future maintenance requirements
Total	£17,016	£61,872	£55,359	£37,594	

Table 3. Summary of baseline economic damages

Component	(£k) Present Value Damages	Key areas of uncertainty
<i>Flood Related Damages</i>		
Flood damages to residential and non-residential properties, risks to life, vehicle damages, emergency services and utilities damages.	£99,767	Extents and severity of flooding. Defence failure/ breach due to defects such as voiding – currently excluded.
<i>Erosion Related Damages</i>		
Loss of properties	[Excluded – up to 60 properties affected]	High level of uncertainty associated with the rates of erosion.
Cambrian Coastal Railway	[Excluded - benefits of protecting this asset are likely to range in the £m's ⁺ and safeguarding of this asset is imperative]	Significant cost uncertainties and lack of available data. Wider context/connectivity.
Recreational Benefits	[Excluded - the loss of Barmouth North Promenade may reduce the appeal of Barmouth]	North Promenade amenity interdependent on Barmouth South amenities.
Damage to utilities infrastructure (services replacement)	£100	Cost of diversion works & replacement services, timing.
Total	£99,867	
A precautionary and conservative approach has been applied to the assessment. Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) minimises the implication of this limitation on the business case. Significant potential damages are excluded due to uncertainties. In addition to excluded property erosion, loss of the Cambrian Coastal Railway and recreational benefits noted above; no breaches were represented. Baseline defence residual life is <10 years and sensitivity assessment showed breach impact would be significant.		

Benefits provided based on the potential standard of protection provided are summarised in the table below.

Standards of Protection	NPV	Present Value Benefits
	(£k)	(£k)
Baseline	99,867	0
1 in 200 yr. (2019)	32,371	67,396
1 in 100 yr. (2019)	37,662	62,104
1 in 50 yr. (2019)	89,774	9,992
1 in 200 year (2069)	16,604	83,162
1 in 100 year (2069)	12,855	86,912
1 in 50 year (2069)	29,229	70,538

Scheme delivery costs were estimated based on recent FCERM scheme unit cost information, collated by the Environment Agency. This information was supplemented by information from recent Welsh coastal and Gwynedd Council schemes (e.g. Tywyn (2011)). The inspection and future maintenance costs have been developed based on the present regime undertaken by Gwynedd Council .

Table 32. Proposed scheme preliminary costs (PV £k)

	Option 2	Option 3	Option 4a (Full Study Area)	Option 4b (North Only)	Notes - assumptions, source(s) and dates
OBC to construction:					
Staff costs (Gwynedd Council)	£73	£73	£146	£146	Project management costs (Gwynedd Council, 2019)
Site investigation and surveys	£60	£40	£5,021	£1,874	
Consultants' fees (Outline and Detail Design)	£502	£1,765	£865	£961	Assume 5% of capital construction cost for detailed design stage
Early Contractor Involvement	£25	£25	£25	£25	One off cost
Other costs (specify)	£32	£32	£120	£120	Includes marine licence, consent, monitoring and stakeholder engagement
Optimism Bias	£207	£581	£1,853	£1,381	30% applied to 'OBC to Construction'
Subtotal	£899	£2,516	£8,029	£5,983	
Construction:					
Construction costs	£10,035	£35,307	£17,291	£19,212	PV Capital cost, based on estimates from Tywyn coastal scheme (2011). Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% Option 4: New line of defence estimated from: EA - SC080039 Cost Estimation for Coastal Protection (2007). Includes decommissioning costs.
Utility diversions	-	-	-	-	No diversions anticipated as part of the scheme, based on initial review
Land purchase & compensation	-	-	£12,244	£500	Option 4: Managed Realignment - Assume 57 properties (Option 4a) and 1 property (Option 4b) compensated at value of property in 2019. Assumption subject to further review at detailed design. - £250,000 land purchase costs (Gwynedd Council, 2019)
Optimism Bias	£6,021	£21,184	£17,722	£11,827	60% applied – due to uncertainty pending ongoing study and further survey requirements.
Subtotal	£16,055	£56,492	£47,257	£31,539	
Future costs (scheme implemented at Year 0):					
Maintenance (PV)	£38	£1,790	£45	£45	
Future construction (PV)	-	-	-	-	
Optimism Bias	£23	£1,074	£27	£27	60% applied – as detailed above
Subtotal	£62	£2,864	£72	£72	
Total	£17,016	£61,872	£55,359	£37,594	

SMP2 Approach

Option 3: Beach Management is costly. Significant quantities of beach material are required to build out the beach profile with ongoing long-term maintenance. The height of the crest is significant and may present consenting/construction issues.

Option 4: Managed Realignment is costly and has considerable uncertainty. There are significant risks to remove the existing defences and replace the defences inland. The situation of the Cambrian Railway and adjacent SMP2 Policy Areas ('Hold the Line') requires that a new defence alignment is constructed inland; whilst the existing defences cannot be abandoned without significant investment to be safely decommissioned.

To realign the full length of study frontage (Option 4a) requires the removal of some ~57 existing properties. To realign the northern half of the study frontage (Option 4b) impacts on one commercial property.

Best-practice adaptive pathways approach is proposed. This allows investing now in actions to manage today's risks, monitoring the change in risk over time. A managed adaptive approach involves planning for multiple interventions and investments in the future, although the future choices and the timing of these interventions will be uncertain.

Table 5. Adaptive pathway scenarios considered for the economic assessment

Pathway	Epoch 1 0-20 years	Epoch 2 20-50 years	Epoch 3 50-100 years
A	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>
B	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>	
C	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>
D	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>	
E	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>		
F	Option 2 + Option 3 <i>Adaptive SOP 1 in 200</i>		
G	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>
H	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>	

Table 6. Summary of Economic Appraisal (Please refer to Appendix A for details)

Pathway	PV Flood Damages	PV Flood Benefits	PV Costs	Benefit Cost Ratio	Incremental Benefit Cost Ratio
	(£k)	(£k)	(£k)		
Baseline	£99,867	£0			
Pathway G	£29,221	£70,304	£26,395	2.7	
Pathway A	£26,681	£58,409	£30,639	1.9	0.0
Pathway C	£29,229	£70,538	£31,384	2.2	0.0
Pathway H	£16,596	£82,929	£37,540	2.2	1.1
Pathway B	£16,194	£68,896	£46,949	1.5	0.0
Pathway D	£16,604	£83,163	£48,668	1.7	0.7
Pathway E	£16,604	£83,163	£62,453	1.3	0.0
Pathway F	£16,604	£83,163	£79,676	1.0	0.0

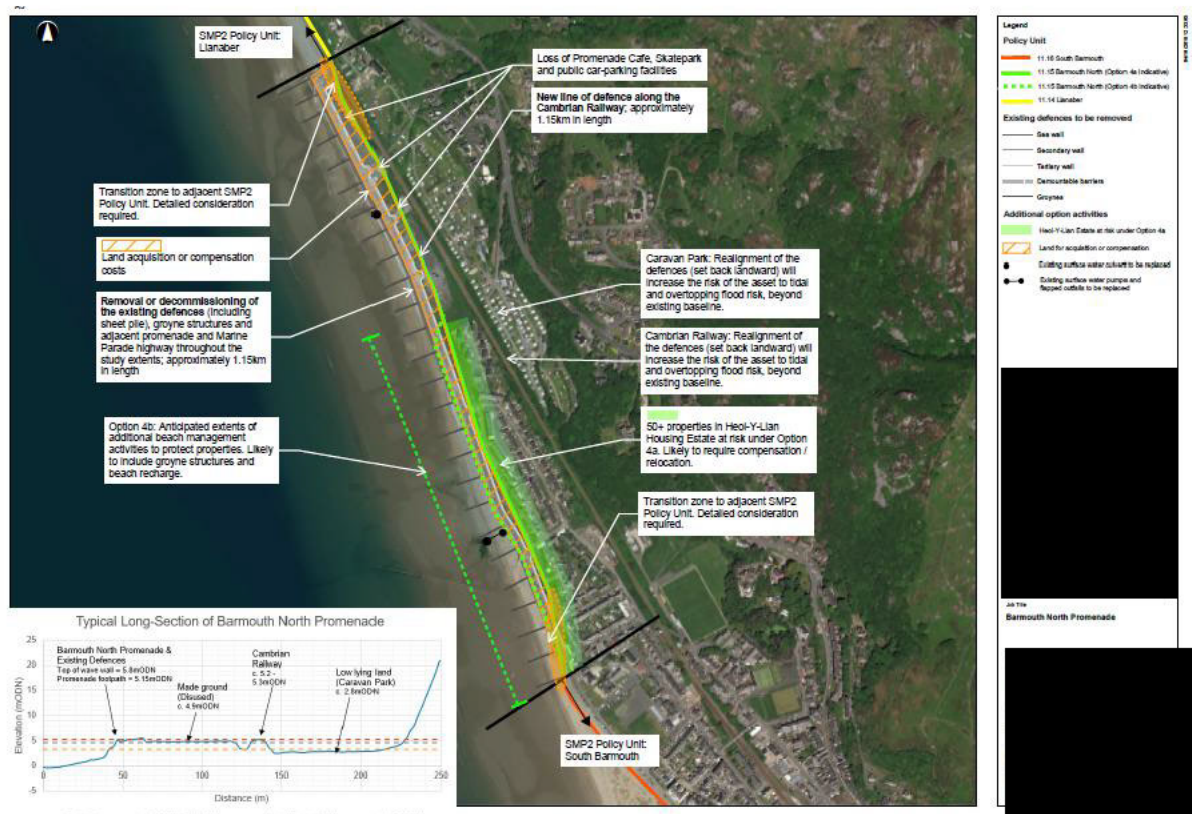


Figure 1: Managed Realignment Sketch. The recommended option is 4b realignment to the north only.

B. Preferred Option

The preferred option is **Option 2: Betterment of the existing defences**. This provides the most economically favourable option and will achieve a 1in50 2069 SOP. It would safeguard the community and the recreational value of the promenade in the medium term.

Beyond 2069, managing coastal risk is increasingly challenging. The most economically favourable option is to transition to a form of managed realignment (to the northern extents only) with beach management activities to the south (i.e. Pathway G). This pathway approach:

- Allows the community to continue to gain tourism, social & well-being benefits from the promenade for a significant duration of the scheme.
- Safeguards residential properties (including social housing).
- Provides flexibility for the uncertainty of climate change. Option 2 can be monitored and the life-span of the promenade extended as much as possible. If sea-level rise and climate change occurs beyond expectations, this pathway retains flexibility for the community/scheme to be adapted as appropriate.
- Provides time for funding mechanisms to be developed which support schemes considering managed realignment.

The preferred approach has a strong justification; with a benefit cost ratio conservatively estimated as 1:2.3. This excludes the benefit of preventing defence breaches. With defence residual life <10 years a breach is anticipated and modelling showed this would significantly increase baseline flood risk.

Option Development

The OBC is seeking approval of Epoch 1 works (Option 2). As such, Option 2 has been developed to an 'outline design' level. A scheme considering transitioning to managed realignment is expected to be developed in the future and as such, remains at shortlisted scheme design.

Outline design included:

- Shoreline modelling to investigate the likely stability of the nourished beach to be built to protect the primary sea wall. Please refer to Appendix C for full details.
- Geophysical Surveys to investigate the current condition of the defences surface with a focus on identifying the location and characterisation of shallow voids.
- Quantified risk assessment for the project.
- Early Contractor Involvement whose input focused on buildability, construction cost and quantified risk assessment.

Wave loading at Barmouth North Promenade is expected to be significant. Initially the preferred option involved improvements to raise the primary wave wall and enhance the wave recurve. However without full construction information or surveys on the existing primary wall the business case cannot assume such works would not destabilise or undermine the performance of the existing defences. To avoid disturbance/destabilisation a new set back flood wall structure is proposed aligned between the promenade/highway to reduce overtopping beyond the promenade.

The preferred option proposes some works to the north of the site owned by [REDACTED] it is assumed that [REDACTED] will contribute to the scheme in-kind through partnership agreement i.e. costs currently exclude BAPA and provisions for line possession.

Additional maintenance activities likely to be required:

- Inspections (annually)
- Minor concrete repairs to primary and flood walls (every 20 years)
- Maintenance of rock armour (every 20 years)
- Allowance for beach re-nourishment and reinstatement (every 50 years) (c. £100k of shingle assumed).

An Initial Environmental Appraisal has been undertaken for the preferred option and outlines a series of recommendations.

Direct habitat loss from the SAC will not occur. However, a further detailed assessment will be required to understand the nature of any indirect impacts on the SAC caused by the import of beach material and the effect of the new rock revetment on the beach.

EIA screening and a Marine licence will be required as work will take place within mean high water tables and is considered beyond 'maintenance and reconstruction' activities.

Limitations and Recommendations

- It is recommended that intrusive/non-intrusive surveys are undertaken at detailed design to understand the performance of primary wall and revetment. The scheme's proposals should be revised accordingly.
- Physical modelling is required at detailed design to understand the wave loading expected to be experienced at Barmouth North Promenade over the design life of the scheme

- Significant residual overtopping to the promenade is predicted. Gwynedd Council will need to monitor and close the promenade / highway during significant storm events.
- A full adaptive pathway should be developed at the next stage – defining milestones, trigger points and monitoring requirements.

Preferred Option Costing

Cost have been updaed for Option 2 (up to 2069). Costs for the managed realignment, after this epoch, have not been updated and are as above.

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Council staff costs	£115	£115	Gwynedd Council costs (2021 weekly rate)
Consultant fees	£506	£506	Assume 5% of construction cost for detailed design stage. Costs to include further detailed modelling to support the detailed design analysis.
Cost consultant	£19	£19	1 day/week for 45 weeks for £55/hr
Site investigation/survey	£78	£78	- o Trial pits along the promenade for the proposed primary/flood wall and at existing sheet pile - o Structural coring of the existing wall - o Beach windowless sampling, plus boreholes to inform the settlement analysis and foundation details of the proposed rock armour. Will also inform temporary works design and sheet pile refurbishment. Includes 10% contingency.
Utility Diversions	£0	£0	No diversions anticipated, based on initial review. QRA allows for protection of sea outfall.
Early Contractor Involvement	£25	£25	Approach informed by procurement model.
Other	£33	£33	Marine licencing and stakeholder engagement
Optimism bias	£193	£193	26% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.
<i>OBC-Construction Subtotal</i>	<i>£969</i>	<i>£969</i>	<i>Assumed to occur in Year 0.</i>
Construction and Construction Support	£17,682	£17,682	PV Capital cost, based on estimate from YGC's Early Contractor Advisor. Includes: - o Preliminaries: 36 weeks at £25,000/wks. - o Material stock piling: 52 weeks at £5,000/wks. - o Profit + overheads: 10% of total direct cost + preliminaries + material stock piling - o Quantified Risk Assessment 95%ile (Appendix H). Construction Period: May 2022 to December 2022
Optimism bias	£4,597	£4,597	26% applied to 'OBC-Construction' and 'Construction' costs due to uncertainty pre- survey and design.
<i>Subtotal</i>	<i>£23,248</i>	<i>£23,248</i>	
Future costs (maintenance)	£178	£403	PV Maintenance cost to include minor concrete repair works to sea wall, promenade and reseating of the rock armour and reinstatement of shingle.
Optimism bias	£107	£242	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey.
Total	£23,533	£23,893	

Table 40. Economic summary of the preferred option

Economic Summary (100 year appraisal)	
Total PV Benefits (£k) (SOP 1 in 50 year – 2069)	£71,217
PV Cost	Option 2: £23,533 Combined: £30,357
Benefit Cost Ratio (Option 2)	3.0
Benefit Cost Ratio (Option 2 and Option 4a in epoch 3)²⁵	2.3

Risks have been quantified and the 95%ile risk figure of approximately £5m has been included in the budget. Some of the biggest risks are relate to sourcing of materials and unforeseen ground conditions. Licensing and seasonal restrictions are also significant risks.

Two very basic sensitivity tests has been carried out, assuming costs increase by 20% and assuming benefits decrease by 20%. These show that the BCR remains >1 in both instances. This is not best practice for sensitivity testing but shows robustness in the preferred option.

Some public engagement has been done on the shortlisted options. Option 2 (Betterment of Existing Defences) was considered the preferred option as it minimises disruption to the beach.

This included a morning session with all relevant parties from public service organisations outside of Gwynedd Council (including Network Rail, Local Councillors, NRW etc).

5. Procurement Route

The procurement route has been sufficiently developed.

Construction works will need to be published in the Official Journal of the European Union (OJEU).

The procurement process shall be divided into two stages; the Pre-qualification questionnaire (PQQ, Stage 1) and the Tender (Stage 2). The PQQ will consist of a pass/fail section and a question section. The pass/fail section will evaluate the interested contractor's performance.

The PQQ will be assessed by three members of Gwynedd Council staff and this process will filter the interested contractors down to a maximum of five.

The successful contractors will then be entered into the Tender stage, which will consist of a Commercial (70% of tender score) and Quality (30% of tender score) element.

The contract will be let under a NEC4 Option A.

6. Funding and Affordability

Table 43. Annualised project costs

Annualised Project Costs (undiscounted) - excluding maintenance		
Preferred Option - Project Summary (£k) Including Optimism Bias	Yr. 0 (2021/22)	Yr. 1 (2022/23)
- Staff	£52	£63
- Design Development and Capital cost (including inflation)	£854	£22,279
Annual Project Total	£906	£22,342
Cumulative Project Total	£906	£23,248

Table 44. Financial Summary Table

Annualised Funding Profile (undiscounted) - excluding maintenance		
Annualised funding profile for preferred option (£k)	Yr. 0 (2021/22)	Yr. 1 (2022/23)
CRMP (85%)	£770	£19,761
Local (15%)	£136	£3,487
Project Total	£906	£23,248

Table 8. Preliminary Option Costing for Epoch 3

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
OBC to Construction Subtotal	£943	£4,142	
Capital Construction Costs (Year 50-55)	£3,116	£14,481	PV Capital cost, based on estimates from Tywyn coastal scheme. Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% <i>Shingle beach recharge assumes majority of beach material from implementation of Option 2 is maintained and reinstated.</i>
Land purchase and compensation (Year 50)	£114	£516	- £250,000 land purchase costs (Gwynedd Council , 2018) - £250,000 commercial property purchase costs
Future Maintenance Costs (Year 50 – 100)	£92	£771	1 day/week for 45 weeks for £55/hr
Optimism Bias	£ 2,559	£ 11,946	60% applied to all costs due to future uncertainty.
Total	£ 6,824	£ 31,855	

For the Full Business Case Stage, Gwynedd Council will match fund 15% of the cost through existing funds. No suitable match funding opportunities have been identified at present during discussions with Gwynedd Council's Economy and Communities Department.

Therefore, the most likely funding mechanism to achieve the 15% match funding contribution for the construction phase would be through the form of a loan taken out by Gwynedd Council through the existing prudential borrowing powers made available to Local Authorities by the Treasury. Gwynedd Council have approved the inclusion of Barmouth North Promenade Coastal Risk Management Project within the County Asset Management Plan.

The financial section currently states that 15% match funding will be found for the detailed design phase. This is not required.

7. Management Arrangements

The management case has been suitable developed and includes a plan for benefit realisation and contingency planning should the project not be suitable for CRMP.

Activity		Date (DD/MM/YYYY)
1	Submit OBC to WG	28/05/2021
2	Approval of OBC	14/06/2021
3	Procure Full Business Case	05/07/2021
4	Submit Full Business Case to WG	13/10/2021
5	FBC Approval	06/04/2022
6	Procure construction contract.	22/04/2022
7	Start of works on site	23/05/2022
8	Completion of works	04/01/2023

8. Reviewers Recommendation

Summary

This is a well drafted OBC with a clear case for change and a well evidenced and developed preferred option.

The preferred option is Option 2 – Betterment of Existing Defences. This is a combination of increasing the height of the current primary and tertiary wall and providing erosion protection in the form of rock armour at the northern extent and beach nourishment at the southern extent. This option is proposed to last until 2069 where it will provide a 1 in 50 standard of protection, after this point Managed Realignment is proposed. This is a Managed Adaptive approach which is supported by the SMP.

The benefit cost ratio of this option is robust at 2.3. This will provide improved flood protection to 537 properties. The cost of this option is

Note: Gwynedd have indicated that due to project timescales and difficulties in finding match funding they are likely to propose that the defence improvement works are done in two phases

- 1. Improvement to the inland defences**
- 2. Erosion protection works**

There are a number of areas that need to be clarified before this OBC can be approved

Issues to be addressed in this OBC.

Overview

- What is a 50 year in 2069 as a present day (from property number it seems like this is similar to a present day 200 year)? Earlier in the report it is stated that SOP is to be confirmed by further modelling. Is this the case?
- Need a breakdown of how many residential vs non-residential properties the preferred option benefits.

Economic

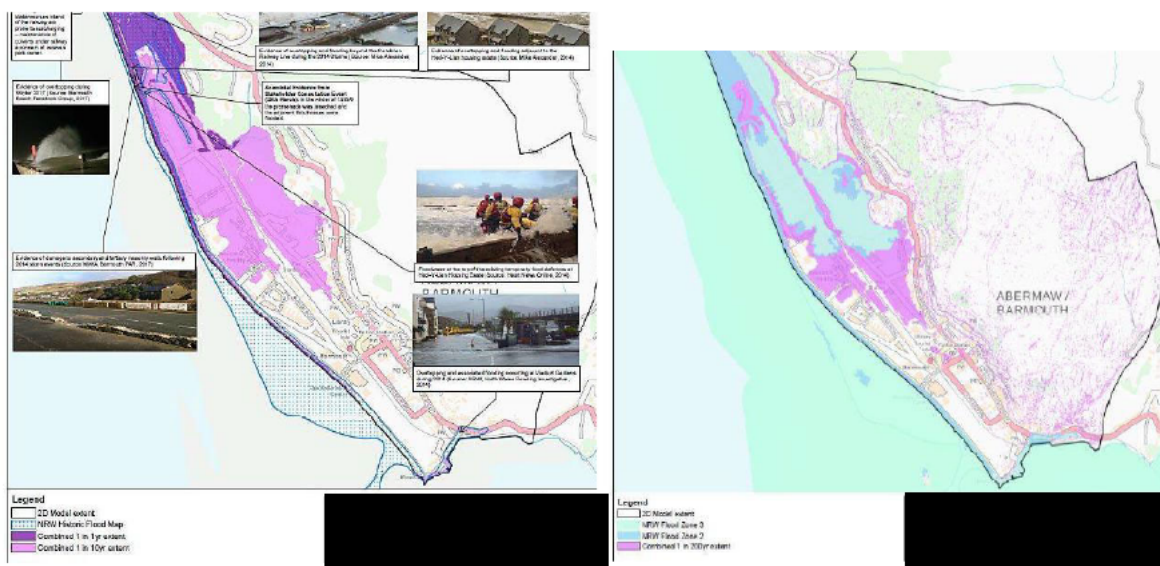
- OB is set at 26%. This is a very specific figure, what is the reasoning behind this?
- Due to the similarity between the baseline Walkaway and Business As Usual Scenarios, the BAU is used as the single baseline. This is considered conservative. Testing sensitivity to features of the Walkaway scenario (economics appendix only)
- Sensitivity testing is very basic (cost +/- 20%). There are a couple of big risks which would be useful as sensitivity test including material costs. Is it worth looking at the impact if MR

doesn't take place, 50 year appraisal period only or Option 2 continues for the full 100 years? To be included in detailed design

- The financial section currently states that 15% match funding will be found for the detailed design phase. This is not required.

Technical

- While the approach is broadly supported in the SMP, the SMP recommends Managed Realignment is from Epoch 2. Does this constitute a change in policy and has the coastal group been consulted?
- Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) reduces the implication of this limitation on the business case.
- Climate change based on 2017 guidance –to be included in detailed design
- Change in beach levels over the 50 years. Is renourishment envisioned over this time? Have overtopping rates for the preferred option been considered with beach levels following draw down?
- An initial environmental assessment have been completed but not an EIA screening. The project is 170m for the Pen Llŷn a'r Sarnau SAC so impacts will have to be assessed. Rivers (e.g. the two ordinary watercourses outfalls in the frontage) are a Welsh Priority Habitat and River Corridors have a Gwynedd council Biodiversity Habitat Action Plan. The sand dune system at South Barmouth is also a priority habitat and a Gwynedd Biodiversity Habitat Action Plan. Works within North Barmouth will need to consider wider the impacts on this neighbouring habitat. This is unlikely to affect the option choice but may impact timescales for the DD works.
- Appendix B – validation (Figure 17 and 18). There are significant areas of southern Barmouth flooded that are not even flooded in the 1 in 200 year NRW maps. Is there a specific reason or system that accounts for this?



Issues related to splitting the works

Gwynedd [REDACTED] are currently producing an addendum to the OBC regarding this proposal.

- The preferred option proposes some works to the north of the site owned by [REDACTED], it is assumed that [REDACTED] will contribute to the scheme in-kind through partnership agreement i.e. costs currently exclude BAPA and provisions for line possession. Is this part of the Phase 1 works? If so this will need to be booked in ASAP as there is a long lead in for this sort of work. What are the state of discussion with NR on this matter?
- A conservative approach has been used throughout, while this is robust I wonder if it is too conservative, particularly if Phase 1 of the scheme is going to have a unitary cost benefit (expected). For example no tourism benefits have been included and the baseline used is BAU rather than Walkaway.
- The BCR of the defence work alone are highly dependent on the residual life of the existing defences it would be useful to have a sensitivity test of the defences lasting say 5, 10 and 15 years.
- Is there likely to be additional maintenance/repair/landscaping works before phase 2?

Section 2

9. Appendix R - Phasing (splitting) of the works

Local Authority	Gwynedd County Council
Project Name	Barmouth North
Type of Report	OBC
Estimated Detailed Design Cost (£k)	£513k £731k
Estimated Construction Cost with Optimism Bias (£k)	£9,986k Spit 1 £19,718k Split 2
Optimism Bias (£k) (%)	26% (design and construction) 60% maintenance
Standard of Protection	1 in 50 in 2069 (>1 in 200 present day)
Number of Properties Protected	447 properties benefitting from scheme (390 residential/57 non-residential)
Benefit Cost Ratio	1:1 Split 1 only 1 : 2.1 over 100 year appraisal
Wider Benefits	Protecting a stretch of the Cambrian Coastal Railway.
Proposed year for construction	2022
Potential Partners	
Other Issues	Approval is requested for works to 2069 only, after this point the scheme reverts to Managed Realignment. The cost benefit ratio is based on the whole scheme. Gwynedd are currently proposing to split initial the works into 2 phases, structural works and beach nourishment works
Location	52.731262, -4.068191

A separate appendix has been provided to present the case for splitting the works into two stages. Stage 1 (called Split 1) would cover repair and improvements to the concrete defences and Stage 2 (called Split 2) would cover works to protect these defences, beach nourishment and rock armour.

Previous comments have not yet been responded to in this report.

It should be noted that this whole project is referred to as Phase 1 of a bigger project. It is not clear what the remaining phase consist of. This is why the terms Phase 1 Split 2 and Phase 1 Split 2 are used.

This would allow Gwynedd to split costs over a greater number of years and allow acceleration of Split 1 to meeting the March 2022 CRMP deadline.

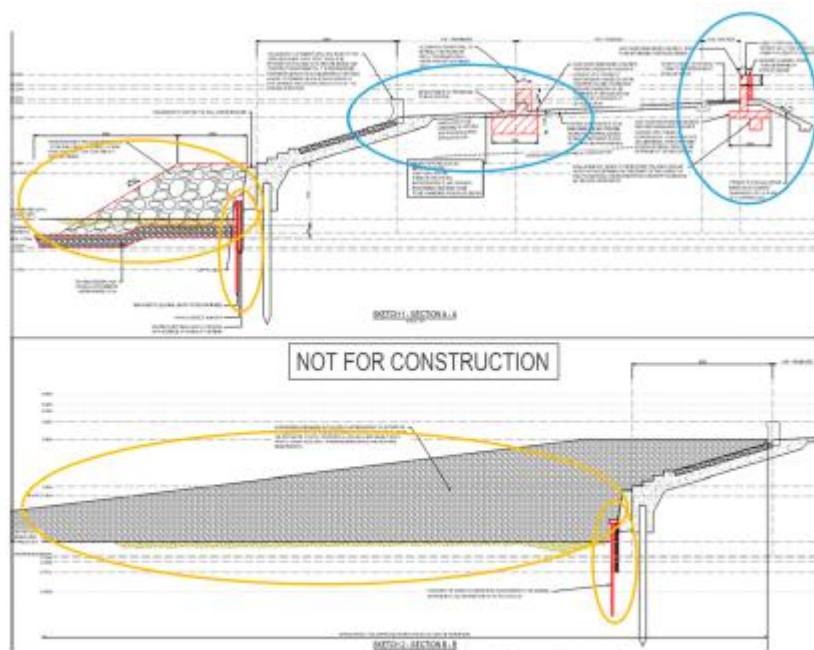


Figure 1: Project typical sections and proposal for phasing (blue – Phase 1 split 1; yellow – Phase 1 split 2)

10. Strategic Case

The strategic case is largely unchanged. High level risks have been split across the two stages. The risk of a damage to the new defences in advance of the beach works is not mentioned.

11. Economic Case

The benefits remain the same for the completed scheme.

Splitting the work increases the total cost of the scheme due to the increases cost of preliminaries, increased material costs and inflation.

Table 3: Impact on non-discounted construction costs of splitting Phase 1

Approach	Construction Costs, risk and construction support (£k)	Optimism Bias (£k)	Total (£k)
Single stage (as per OBC)	£17,682	£4,598	£22,280
Staged			
Phase 1 Split 1 (2021)	£7,343	£1,909	£9,252
Phase 1 Split 2 (2024)	£14,733	£3,831	£18,564
Combined Phase 1 Split 1 and Split 2	£22,076	£5,740	£27,816

Table 4: Phase 1 Split 1 Option costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Council staff costs	£71	£73	Gwynedd Council costs.
Consultant fees	£212	£212	Assume 5% of direct construction cost (without preliminaries, overhead, profit) for detailed design stage.
Cost consultant fees	£12	£12	1 day/week for 30 weeks for £55/hr
Site investigation/survey	£78	£78	- o Trial pits along the promenade for the proposed secondary/ tertiary wall and at existing sheet pile - o Structural coring of the existing wall to inform the design - o Windowless sampling along the beach, supplemented with a small number of boreholes, to inform the settlement analysis and foundation details of the proposed rock armour. This will also inform the temporary works design for the sheet pile refurbishment. Includes 10% contingency.
Utility Diversions	£0	£0	No diversions anticipated as part of the scheme, based on initial review
Early Contractor Involvement	£13	£13	One off cost to include drawings review, based on previous project experience.
Other	£24	£24	Marine licencing and stakeholder engagement
Optimism bias	£100	£101	26% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.
<i>OBC to Construction Subtotal</i>	<i>£511</i>	<i>£513</i>	
Construction and Construction Support	£7,094	£7,343	PV Capital cost, based on estimate from ECI. Includes: - Preliminaries: 30 weeks - Profit + overheads: 10% of total direct cost + preliminaries - Quantified Risk Assessment 95%ile
Optimism bias	£1,845	£1,909	26% applied to 'Construction' costs due to uncertainty pending ongoing study and further survey.
<i>Subtotal</i>	<i>£9,449</i>	<i>£9,764</i>	
Future costs (maintenance)	£70	£139	PV maintenance costs include minor concrete repair works to seawall and operation and maintenance of flood gates.
Optimism bias	£42	£83	60% applied to 'Maintenance' costs due to uncertainty pending ongoing study and further survey.
Total	£9,561	£9,986	

Table 5: Phase 1 Split 2 Option costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Council staff costs	£91	£103	Gwynedd Council costs.
Consultant fees	£393	£421	Assume 5% of direct construction cost (without preliminaries, overhead, profit) for detailed design stage.
Cost consultant fees	£16	£17	1 day/week for 36 weeks for £59/hr
Site investigation/survey	£0	£0	Surveys undertaken in Phase 1 Split 2
Utility Diversions	£0	£0	No diversions anticipated as part of the scheme, based on initial review
Early Contractor Involvement	£13	£14	One off cost to include drawings review, based on previous project experience.
Other	£30	£33	Marine licencing and stakeholder engagement
Optimism bias	£133	£144	26% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.
<i>OBC to Construction Subtotal</i>	<i>£677</i>	<i>£731</i>	
Construction and Construction Support	£12,839	£14,733	PV Capital cost, based on estimate from ECI. Includes: - Preliminaries: 36 weeks - Material stock piling: 52 weeks - Profit + overheads: 10% of total direct cost + preliminaries + material stock piling - Quantified Risk Assessment 95%ile
Optimism bias	£3,338	£3,831	26% applied to 'Construction' costs due to uncertainty pending ongoing study and further survey.
<i>Subtotal</i>	<i>£16,854</i>	<i>£19,295</i>	
Future costs (maintenance)	£108	£264	PV maintenance costs include maintenance of rock armour and shingle replenishment.
Optimism bias	£65	£158	60% applied to 'Maintenance' costs due to uncertainty pending ongoing study and further survey.
Total	£17,027	£19,718	

The Benefit Cost Ratio has been calculated for each stage. It is unclear whether the BCR is for Split 2 is for just this phase or for the whole scheme. Earlier in the report it states that the whole project BCR is reduced, when compared to the single phase, from 3.0 to 2.6.

There is very little detail as to how this calculation was done. For example on the timing of the phases and the appraisal period. This is key to understanding these figures.

Table 6: Present Value Benefits and BCR expected for single stage and split approach

Approach	Present Value Damages (PVD) (£k)	Present Value Benefits (£k)	Benefit/cost ratio
Baseline	£99,867	-	-
Single stage (as per OBC)	£29,221	£70,304	3.0
Staged			
Phase 1 Split 1	£90,516	£9,251	1.0
Phase 1 Split 2		£61,053	3.6

12. Commercial case

The commercial case states that the detailed design phase for both split 1 and split 2 will be procured and completed together but then an FBC for Phase 1 only will be produced.

13. Financial Case

The financial case includes the following commitment from Gwynedd with regards to funding the scheme.

“Gwynedd Council are committed to the scheme. Discussions between Council management team and Cabinet to secure full match funding allocation are ongoing as a priority. Gwynedd Council have approved the inclusion of Barmouth North Promenade Coastal Risk Management Project within the County Asset Management Plan.

Match funding contribution [for Split 2] will be part of the new Asset management programme to be determined around 2024. Discussions with Welsh Government are planned as an approach beyond the current Coastal Risk Management Programme is developed for the funding of schemes beyond 2022.”

The timing and confirmation of funding for Split 2 remains a risk.

Table 7: Annualised project costs

Annualised Project Costs (undiscounted) - excluding maintenance					
Preferred Option - Project Summary (£k) Including Optimism Bias	Phase 1 split 1		Phase 1 split 2		
	Yr. 0 (2021/22)	Yr. 1 (2022/23)	Yr. 2 (2023/24)	Yr. 3 (2024/25)	Yr. 4 (2025/26)
- Staff	£25	£47	£8	£24	£71
- Design Development and Capital cost (including inflation)	£440	£9,252	£314	£314	£18,564
Annual Project Total	£465	£9,299	£322	£338	£18,635
Cumulative Project Total	£465	£9,764	£10,086	£10,424	£29,059

14. Management Case

The following timetable has been proposed

Table 9. Project Milestones

Activity		Date (DD/MM/YYYY)
1	Submit OBC to WG	20/08/2021
2	Approval of OBC	27/08/2021
3	RIBA 3 Design entire scheme	17/12/2021
4	Submit Full Business Case for Phase 1 to WG	03/12/2021
5	Phase 1 Detail Design	17/02/2022
6	Phase 1 FBC Approval	19/01/2022
7	Procure Phase 1 construction contract.	03/03/2022
8	Start of works on site Phase 1	31/03/2022
9	Completion of works Phase 1	25/08/2022
10	Submit Full Business Case for Phase 2 to WG	03/01/2024
11	Phase 2 Detail Design	25/10/2023
12	Phase 2 FBC Approval	03/07/2024
13	Procure Phase 2 construction contract.	11/02/2025
14	Start of works on site Phase 2	12/03/2025
15	Completion of works Phase 2	13/11/2025

A fully costed risk register has been produced and for both Split 1 and Split 2.

- 15% funding risk removed from Split 1
- Physical modelling is mentioned is this achievable within the timeframe?
- Failure to meet CRMP deadline not on risk register
- There is little in here on the potential risks of phasing the work. i.e the risk of storm damage in the three years between completion of Phase 1 and completion of phase 2. Reputation risk of double the disruption.
- It would also be useful to see some sensitivity testing on the timing of these phases.

15. Review Summary and Recommendation

Summary

Previous comments on the main OBC have not been taken into account in the drafting of this report and therefore still stand.

Gwynedd propose splitting the works into 2 stages Split 1 (linear defence works) to be constructed in 2022 at a cost of £9.5 million an Split 2 (beach and rock armour works) to be constructed in 2025 at a cost of £19.7 million (£17 million PV cost). Splitting the works results in an increase in construction costs of around £5.5 million. It is unclear whether there would also be an additional OBC to Construction cost.

There are several areas of this appendix that would benefits from further exploration (in addition to comments made previously on the OBC)

Economics

Further clarity is required on the approach to the economics. It is unclear on the approach and assumptions used in developing the economics and how these relate to each other. For example:

- Assumed asset life in Split 1 and assumed failure condition i.e. is this based on a breach or a different approach
- Appraisal period used for both Split 1 and Split 2.

- Table 6 - Whether the BCR of 3.6 is for just this stage (Split) or for the whole scheme. Earlier in the report it is stated that the overall BCR for the two stage option is 2.6.
- Table 6 - Why damages are reported as the same for both stages.

The BCRs reported in the economics section for the single phase approach (of 3.0) appear to be from the Option 2 only, which only covered the first 50 years of the appraisal period. From the main OBC, I believe the whole life BCR is 2.3. Do the BCRs presented in Table 3 include for managed realignment in 2069.

Benefits

Benefits for each stage have been presented in Table 6. It is assumed the difference in benefit is due to the different life of these two phases but this is not explicitly stated. It is unclear the number of properties and the standard of protection provided by each stage.

Costs

Cost are also somewhat unclear and there appears to be inconsistencies between tables.

- Are the costs in Table 3 PV costs or non-discounted costs.
- Local at total costs (including development costs) the difference between the two approaches is £5.81 million. Looking at construction costs only the difference is £5.54 million.
- Table 4 and 5 indicate that there will be development costs for both phases but the approach mentions that detailed design for both stages will be done together. What is the assumption here? Have costs been approximately split between the two stages or are there additional development costs resulting from splitting the work in this manner (compared to doing the scheme as one phase)?

Risks

A risk register has been included but there is no obvious consideration of some of the key strategic risks to this approach. For example:

- The risk of storm damage in the three years between completion of Phase 1 and completion of phase 2.
- Reputation risk of double the disruption.
- Failure to meet the CRMP deadline for Split 1
- NRW objecting to splitting the works for Marine license purposes
- Risk of not being able to find funding for Split 2 or delays in finding funding

It would be good to see some consideration of sort of these strategic risks, potentially in terms of sensitivity testing of the results.

We need to confirm property numbers. Splitting the works in this way is going to make it difficult to claim properties protected under each phase. This is going to mean that when Phase 2 works hit the capital programme this will be a £20 million scheme with no properties to claim. This will be difficult to prioritise.

Question to ask Gwynedd

Welsh Government are not opposed to the idea of phasing this scheme, however, there are some factors of this approach that need to be understood first. I have summarized these below but I think it would be best if we arrange a meeting to discuss.

Can you please confirm the standard of protection and the numbers of residential and non-residential properties benefitting from each phase?

Is it an option to pause all works and construct the whole scheme in 2025, what would be the advantages and disadvantages of this approach compared to the preferred option?

What is the risk of storm damage to the Split 1 defences in the three years between completion of the first Split and start of the Second? What is the likelihood of remedial works being required and what is the likely severity or extent? How would this compare to damage to existing defences under the same conditions.

Split 2 works are going to be difficult to justify in the main capital programme due to its large size and that most properties will have already been claimed under Split 1. Will delay Split 2 to this work help unlock potential external funding, for example from Network Rail?

Additional Comments To Be Addressed.

Comments provided on the main OBC on 28th October are still outstanding.

Can you please provide more detail on the approach and assumptions used for the economics in this appendix?

- Do the cost benefit ratios presented in this report and specifically Table 6 include managed realignment in 2069.
- What is the updated cost benefit ratio of the whole scheme over the 100 year appraisal period, assuming the two stage split and the managed realignment in 2069 (the preferred option).
- In Table 6 how has the cost benefit ratio for Phase 1 Split 2 been calculated? Why are the damages the same for Split 1 and Split 2? What is the time period these benefits are counted for in Split 2, e.g. does this run from year 10 to year 99, or year 10 to 2069, or from 2025 to 2069?

Are increases in cost related purely to the construction work or are there also changes in design and development costs (such as the cost of drafting two sets or reporting).

It would be good to see an exploration of the risks and benefits/opportunities associated with phasing approach. I can see several potential risks which are not included in the risk register:

- Reputation risk of double the disruption from doing works on the same frontage twice in a relatively short timeline.
- Failure to meet the CRMP deadline for Split 1
- NRW objecting to splitting the works for Marine license purposes
- Risk of not being able to find funding for Split 2 or delays in finding funding

In particular it would be good to see some further information and discussion on the following

- The 1.0 BCR for Phase 1 is highly dependent on the life of the existing defences how certain is this?

Section 3

Responses to question from both Section 1 and Section 2 of this review were answered in a separate note. Responses are summarised below.

These comments were discussed in a meeting with Gwynedd and [REDACTED] on 6/10/21 and with Gwynedd on 19/10/2021. These conversation were focused on the phasing of the scheme the key points are summarised in an accompanying briefing note "Barmouth North CRMP Scheme Phasing - Briefing Note - Oct 2021"

Reviewers Recommendation

It is recommended that this project proceeds to FBC pending confirmation of the preferred delivery approach from Gwynedd and confirmation of the number of residential and non-residential properties.

The preferred options is considered appropriate and the adaptive management approach to managed realignment is supported. The cost benefit ratio of the scheme as a whole (including managed realignment) is 2.3 if done as a single phase and 2.1 if a phased approach is taken.

Welsh Government have discussed the phasing proposal and feel like although this makes sense from a technical perspective it would be difficult to justify from a programme perspective, especially considering the additional cost.

Detailed review of comment responses below.

Comment Responses

Section 1 – Main OBC - Overview

Present day SOP Approximately 1 in 200
Can you please confirm the number of properties benefitting from the preferred option including a breakdown residential vs non-residential 519 properties benefit from the scheme – property split 440 residential/79 non-residential.

Section 1 – Main OBC - Economic

Optimism Bias is set at 26%. This is based on the EA Risk Guidance calculator
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Section 1 – Main OBC - Technical

While the approach is broadly supported in the SMP, the SMP recommends Managed Realignment from Epoch 2. Does this constitute a change in policy and has the coastal group been consulted? Discussions have been held with Emlyn Jones (Chair of Coastal Group) to seek compliance with SMP policy through adaptive pathway. Formal consultation is outside the remit of the Coastal Group for OBC assurance.
The preferred option proposes some works to the north of the site to tie-in to Network Rail. What is this tie-in expected to look like? Further work is needed in detailed design but this is likely to be curtailing the setback walls and providing erosion protection with rock revetment. Initial discussions with [REDACTED] been held to inform the OBC Financial Case - whilst proposals afford protection to NR assets and happy to accommodate within consenting process, no contribution. Track levels still TBC

I couldn't find and utilities drawings. Confirmed that searches have been done and not much found.
What is the expected change in beach levels in the 50 years, before managed realignment? 1 or 2 nourishment campaigns are expected over the assets life. Levels will be kept sufficient to protect the toe of the wall.
Appendix B – Model Validation. The model results are different to the NRW model due to the increased detail through items such as breach modelling. [REDACTED] are comfortable with the outputs and that they match observed levels from historic floods.

Section 2 (Phasing Appendix) Comment Response

Can you please confirm the standard of protection and the numbers of residential and non-residential properties benefitting from Phase 1 Split 1 and Phase 1 Split 2? 447 properties are protected by both "Splits". Split 2 greatly extends the life of the defences.
Is it an option to pause all works and construct the whole scheme in 2025, what would be the advantages and disadvantages of this approach compared to the preferred option? Advantages: - Minimises risks associated to programme/funding driven by the requirement of starting the works on site by March 2022 - Reduces the programme duration and allows some construction activities to overlap which could have a positive impact in cost (e.g. reduced preliminaries). - Reduces the cost of mobilisation and demobilisation. - Reduces disruption to public. Disadvantages: - Increased risk of the existing defences breaching - Increased risk of flooding and damage to people and properties. - Increased uncertainty on the cost of the scheme driven by uncertainty on material costs and inflation. However phase 1 is sizeable in the context of the WG/Council programme budget and also the community/access. Splitting phase 1 is attractive: - Increases affordability by reducing in year budget commitments and allows flexibility. - Reduces intensity of disruption / impact on local community whilst increasing duration. - Increases function of existing defences to better protect properties from flood risk at the earliest opportunity. - Engagement with Planners, Highways and NRW ongoing. All view split approach positively, subject to further details noting majority of consenting risk relates to split two 'intertidal' works.
What is the risk of storm damage to the Split 1 defences in the three years between completion of the first Split and start of the Second? The risk of storm damage to Split 1 defences between completion of Split 1 and Split 2 is low to medium. The risk of storm damage is reduced by including maintenance and void filling of the existing defences as part of Split 1.
Will delaying Split 2 help unlock potential external funding, for example from Network Rail? None identified.
What is the updated cost benefit ratio of the whole scheme over the 100 year appraisal period, assuming the two stage split and the managed realignment in 2069 (the preferred option). 2.1
Are increases in cost related purely to the construction work or are there also changes in design and development costs (such as the cost of drafting two sets or reporting). There will be a slight increase in design cost. As currently calculated design costs are 5% of construction costs.

It would be good to see an exploration of the risks and benefits/opportunities associated with phasing approach. I can see several potential risks which are not included in the risk register. Risk register to be reviewed at FBC.