

Cyngor Gwynedd

Barmouth North Promenade FAS

ES Chapter 2 Project Description

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2. Project Description

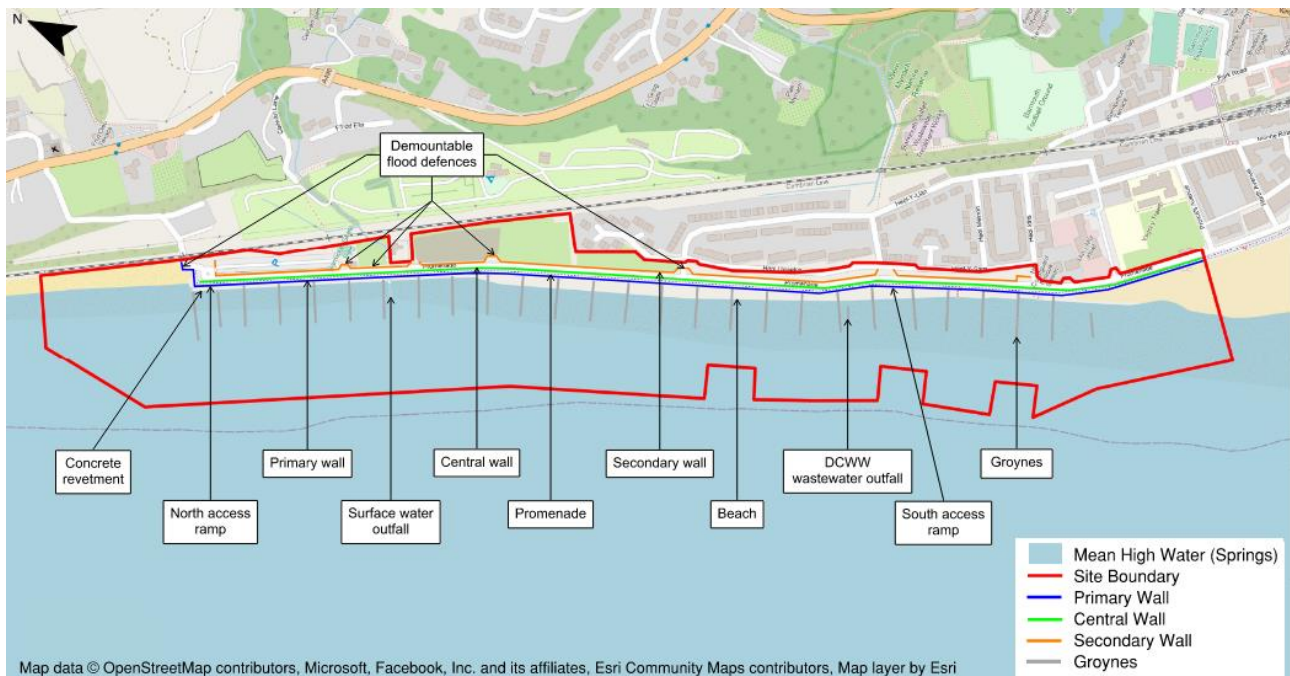
2.1 Introduction

- 2.1.1 This chapter outlines the Proposed Development, and provides a description of its main components, including an outline of construction and operational requirements.
- 2.1.2 The Proposed Development at Barmouth North Promenade comprises new and improved sea defences, placemaking and surface water drainage improvements. The Proposed Development will provide a standard of protection (SoP) of 1 in 50-year annual chance (2% annual exceedance probability). For each element of the design, the proposed construction methods and materials are provided with an overview of the duration of construction and considerations for programming.
- 2.1.3 Where measures to avoid, reduce or minimise environmental effects were incorporated within the final design and the relevant reference design drawings, these are identified within the relevant topic chapters under the heading of embedded environmental design measures and taken into account in the assessments.

2.2 Site Location

- 2.2.1 The Proposed Development is located within Barmouth North Promenade. A site plan presenting the existing arrangements and assets is shown below in Graphic 2-1.

Graphic 2-1 Site Plan showing existing arrangement.



2.3 Proposed Coastal Defence Works

- 2.3.1 An overview of the Proposed Development is presented in ES Volume 4, Figure 2.1- Outline Design Layout Site Plan.

2.3.2 Design General Arrangements and Cross Sections for the Proposed Development have been submitted with the planning application as below:

- BMTH-ARP-HGN-PROM-DR-Z-000003 - OUTLINE DESIGN LAYOUTS GENERAL ARRANGEMENT - SHEET 1 OF 5
- BMTH-ARP-HGN-PROM-DR-Z-000004 - OUTLINE DESIGN LAYOUTS GENERAL ARRANGEMENT - SHEET 2 OF 5
- BMTH-ARP-HGN-PROM-DR-Z-000005 - OUTLINE DESIGN LAYOUTS GENERAL ARRANGEMENT - SHEET 3 OF 5
- BMTH-ARP-HGN-PROM-DR-Z-000006 - OUTLINE DESIGN LAYOUTS GENERAL ARRANGEMENT - SHEET 4 OF 5
- BMTH-ARP-HGN-PROM-DR-Z-000007 - OUTLINE DESIGN LAYOUTS GENERAL ARRANGEMENT - SHEET 5 OF 5
- BMTH-ARP-HGN-ZZ-DR-Z-000001 - TYPICAL CROSS SECTIONS - SHEET 1 OF 5
- BMTH-ARP-HGN-ZZ-DR-Z-000002 - TYPICAL CROSS SECTIONS - SHEET 2 OF 5
- BMTH-ARP-HGN-ZZ-DR-Z-000003 - TYPICAL CROSS SECTIONS - SHEET 3 OF 5
- BMTH-ARP-HGN-ZZ-DR-Z-000004 - TYPICAL CROSS SECTIONS - SHEET 4 OF 5
- BMTH-ARP-HGN-ZZ-DR-Z-000005 - TYPICAL CROSS SECTIONS - SHEET 5 OF 5

2.3.3 Key assets are detailed in Table 2-1 with a brief description of the proposed works for each location in the Proposed Development.

Table 2-1 Proposed coastal defence works

Asset	Existing Description	Proposed Development
Beach	The Beach is primarily made up of sand with a shingle berm north of the promenade and dunes to the south. There is some coarse sediment (cobble/boulders) in the southern extent of the site and a coarse sediment fillet along northern half the frontage. To the south, the beach widens with sand dunes.	New rock revetment to be constructed at the top of the beach (950m in length) utilising rock armour (boulders) of a maximum grading of 3-6t. No other material is to be added to the beach. [Please note - at the time of preparing the Environmental Statement, additional areas of rock armour were included in some assessments to ensure a "conservative" scenario was considered. Through further physical modelling and flood modelling it has been determined that these areas are not required and has been subsequently removed from the Scheme, however some of the assessments still include it.] Coarse sediments will be redistributed along the beach front rather than being removed. The coordinates for the rock revetment include:

Asset	Existing Description	Proposed Development
		Northwest end of rock revetment: 260187, 317354 and southeast end of rock revetment: 260613, 316390
Groynes	Timber groynes situated in front of the northern promenade at roughly 45m intervals, the majority of which have damaged and/or missing boards.	The groynes are to be removed. Refurbishment is not proposed or required as part of the Proposed Development.
Concrete revetment	A concrete revetment runs at the top of the beach. A sheet pile cut-off toe has been installed running along its length, buried in the sand.	The existing concrete revetment is to remain. Existing sheet piles to be refurbished over a ~950m length to the north of the promenade, including a capping beam which will also be accessible to pedestrians for recreation. Existing buried concrete apron to the South of the Proposed Development to be covered by proposed rock armour.
Primary wall	Precast concrete wave recurve wall units.	The primary wall is to remain, with localised patch repairs to joints and sealant where required. The coordinates for the primary wall include: Northwest end of primary wall: 260282, 317263 and southeast end of primary wall: 260800, 316057.
Central wall	Separating the promenade and highway, an unreinforced stone wall with large sections of missing stones and many drainage holes. There are benches built into the wall and several access points enabling access between the beach and highway via the promenade.	The central wall is not required to provide a flood defence function. It will therefore be replaced with a new kerb and balustrade to provide separation between the promenade and highway.
Secondary wall	Unreinforced stone wall running parallel to the Central Wall on the opposite side of the Marine Parade highway, with demountable flood defences (stop logs) at multiple locations as below.	New reinforced concrete wall, generally on the alignment of the existing defective secondary wall. Max height of 1.55m, which may vary across length. Facing the promenade, the wall will include a concave recurve shape. Where feasible, the wall will have a textured concrete finish. The secondary wall runs from Heol Idris to and around the North Promenade Car Park, tying into the existing railway level crossing. The foundations of the wall will be designed to allow for future raising by up to 150mm. This is estimated to be required in 2055 but will be subject to further monitoring of storms and water

Asset	Existing Description	Proposed Development
		levels, and would require its own consenting process. The coordinates for the secondary wall include: Northwest end of secondary wall: 260364, 317114 and southeast end of secondary wall: 260800, 316057.
Demountable flood defences	Wooden boards slotted into stop logs bridging the gaps in the secondary wall at access points. Many demountable defences are in place as the default position.	Existing stoplogs will be replaced with either a continuation of the secondary wall, or flood gates. A total of nine number flood gates are to be installed
Promenade	A concrete walkway along the sea front from South to North Barmouth, running between the primary and central walls.	Raised planters, cycle stands, seating and other street furniture will be included. New street lighting is proposed.
Beach access ramps	Existing access ramps provided at the north and south of the promenade. Existing gradients (1:7 at North, 1:15 at South) pose accessibility challenges.	Existing ramp to the north of the Proposed Development to be rebuilt/extended at 1:21 gradient, extending up to 1.7m below beach level.
Beach access steps	Existing access steps, within the concrete revetment, are provided at regular intervals (100-150m) along the promenade. Due to erosion, many of these are in poor condition and provide access to the concrete revetment only, not beach level.	The access steps within the scheme extents (6 no.) will be rebuilt, complying with relevant standards to improve accessibility, and extended through the rock revetment to the beach, extending up to 1.7m below beach level.
Promenade access ramp	An existing landward ramp with a 1:6 slope connects Marine Parade, with the junction of Heol-Llywelyn, Heol-y-Sarn and Heol-y-Plas heading landward.	The existing landward ramp will be removed and replaced with both steps and a new ramp with a gradient of 1:21 or shallower.
Highway	The single carriageway Marine Parade runs the entire length of the promenade between the central and secondary walls. The seaward side is demarcated for parking, and there is a pavement on the landward side.	The carriageway will be resurfaced as part of the Proposed Development. Car parking demarcation is to be switched to the landward side of the road to reduce the risk of clash with the central balustrade, and improve access to the pavement. Crossing points are to be added to improve accessibility and safety for pedestrians.
Outfalls	One culverted watercourse discharges to the sea at the North of the site. Two DCWW outfalls extend under the promenade to discharge at the beach. There is also a pumped surface water drainage system.	The surface water pumping station and DCWW outfalls are not included as part of the scope of the Proposed Development. These will be protected during construction only. The outfall by the café is to be extended under the proposed rock

Asset	Existing Description	Proposed Development
		revetment and refurbished (including non-return valve).
Landscape and Public Realm	The existing north promenade is very limited in terms of amenity provision both for soft and hard landscape. Green areas and planting are absent along the promenade and road corridor. A number of moveable raise planters with palm trees are placed along the southern promenade and extend nearer the school Ysgol Y Traeth but do not encroach into the Proposed Development. The only areas of grass are located behind the secondary wall and adjacent to the residential areas. However, these are maintained as amenity grass, with limited aesthetic value. Seating areas are provided along the central wall and in limited locations along the secondary wall, however these have fallen into disrepair due to storm damage to the central wall and are not to current inclusivity standards. The promenade surface is showing its age and feels worn, with visible signs of cracking and patched up areas. Lighting columns are present along the secondary wall, however the light spill coverage appears insufficient, resulting in a non-uniform coverage and multiple dark areas along the promenade.	The following measures will be proposed as part of the public spaces design both in terms soft and hard landscape: - Improved and increased seating areas. - Raised planters with vegetation at key nodes and more significant amenity green areas around the northern car park. - Improved road crossing points for pedestrians. - Delineated areas for commercial activities (e.g. designated locations for food and beverage trucks) near the northern car park. - Cycle parking areas. - Improved signage/wayfinding. - Improved access to beach through the rock revetment. - Improved lighting provision.

2.3.4 A more detailed description of the Proposed Development is given below.

2.3.5 A 950m-long rock revetment will be the first formal line of defence against coastal flooding. The rock revetment arrangement is as follows for the majority of its extent, although levels vary and the rock revetment widens at the northern end. The rock revetment begins at beach level (approx. 0mAOD) and ramps up in two stages to meet the concrete revetment. The rock revetment initially ramps up at a 1 in 1.5 gradient over a distance of approximately 3.2m and levels off to form a 2.8m long landing. The second incline is at a 1 in 3 gradient over a distance of ~2.5m finishing with an 8m level section.

2.3.6 The rock revetment ramps up from beach level at a 1 in 1.5 gradient for 3.6m and levels out to create a 3.6m landing, then ramps up at a 1 in 3 gradient for ~4.5m and levels out at the crest for 4.8m. The rock revetment ramps down on the landward side creating a symmetrical section.

2.3.7 Approximately 48000t of primary rock and 15000t of smaller graded material is required for the entire rock revetment. The source of materials are discussed in section 2.12.

2.3.8 A concrete capping beam will be laid over the flat portion of the existing concrete revetment to allow limited amenity use. This will include an upstand to discourage access to the rock revetment.

- 2.3.9 The existing beach access steps in the concrete revetment will be refurbished and extended through the rock revetment to the beach. There will be six 2m-wide stepped access points consisting of flat landings in line with the rock revetment and steps where the rock revetment is sloped. The new steps are to be precast concrete elements, supported by sheet piles.
- 2.3.10 The north access ramps will be extended to provide access to maintenance vehicles and improve accessibility through the new rock revetment. Similar to the steps, these are to be precast concrete supported by sheet piles.
- 2.3.11 The primary wall separates the promenade from the beach. The existing wall will remain unchanged aside from localised repairs as needed. The promenade will typically be 5.3m wide and continue to provide the main active travel route along the seafront. Various low maintenance placemaking features such as benches and planting will be installed along the promenade.
- 2.3.12 The existing central wall will be demolished and replaced with a kerb and balustrade to provide separation between the promenade and highway. Several openings will be incorporated into the wall, including at formalised pedestrian crossing points along Marine Parade, which align with openings in the secondary wall.
- 2.3.13 The carriageway will be resurfaced as part of the Proposed Development. Car parking demarcation is to be switched to the landward side of the road, and crossing points are to be added to improve access.
- 2.3.14 The layout of the car park at the north of the site, and associated surrounding infrastructure, will be redesigned to rationalise vehicle movements and parking, while enhancing active travel provision, amenity spaces, and public realm features.
- 2.3.15 The secondary wall will be rebuilt in reinforced concrete and raised to a maximum height of 1.55m. The face of the wall facing the sea will include a concave recurve shape. The rear vertical face (and possibly the front face) will have a textured concrete finish. The wall will extend around the rear of the car park, between the car park and railway. In this section, it will be constructed entirely in concrete and will not include a recurve.
- 2.3.16 There are nine new flood gates in the Proposed Development, located along the primary and secondary walls. This includes across the Network Rail level crossings, and across access points to adjoining roads such as Heol Idris and Heol-y-Llan. Four of the flood gates will replace existing stop logs, the remaining five are located where there were previously gaps in the line of defence.
- 2.3.17 The existing lighting columns on the promenade will be removed and new columns will be installed along the promenade to increase illumination of the promenade and roadway, whilst reducing light spill which currently occurs with the existing arrangement. The lighting has been designed as:
- Tall asymmetric double lighting columns (8m-10m height) positioned at regular intervals.
 - Well-shielded luminaires with asymmetric optics for precise light direction.
 - Designed to light the road and the promenade.
 - Warm white light sources (max 2700K) to reduce impacts on ecological receptors.

2.4 Landscape and Public Realm

- 2.4.1 The landscape design has been developed alongside the coastal defences from concept to outline design, before progressing to detail design. Each aspect has carefully considered the broader context of the area including the natural landscape, heritage, industrial and socio-economic characteristics to deliver a design that responds to the local identity and character.
- 2.4.2 The landscape design has been developed to suit the coastal environment and minimise maintenance requirements in order to reduce operational costs and ensure the elements of the design are robust and long lasting.

Hard landscape

- 2.4.3 Access to the beach, promenade and Marine Parade has been designed considering the views of the local community expressed through public consultation events. All footpaths included in the works will be at least 1.8m in width.
- 2.4.4 Any new signage shall be positioned at a height and of a size which allows wheelchair users and mobility scooters to read comfortably.
- 2.4.5 Wayfinding signage will be improved and rationalised to identify key assets of the area such as recreational routes, the Wales Coast Path and the national cycle network route.
- 2.4.6 Designated cycle parking locations will be dotted throughout the Proposed Development, and carefully located to minimise obstructions along circulation routes.
- 2.4.7 New walls will be designed to minimise visual intrusion in terms of height, profile and finishes. Textured concrete patterns will be used to improve the aesthetic value and mitigate the barren appearance of concrete structures.
- 2.4.8 A significant dwell area will be created at the northern end of the promenade, interfacing with the Carpark. This area will accommodate large seating areas, delineated spaces for kiosks and temporary commercial activities. Improvements to the car park will include a revised layout, integrated green spaces, improved accessibility and provision of disabled parking bays.
- 2.4.9 Smaller dwell areas will be provided at key nodes along the promenade and be comprised of raised planters and new seating installations. These nodes will also create safe and inclusive crossing points for pedestrians to cross the road. Surfacing finishes will be improved within these crossing points to help decrease vehicle speeds and create a safer environment for pedestrians.
- 2.4.10 Handrails will be installed on new steps and ramps throughout the Proposed Development.
- 2.4.11 New lighting columns will be installed with split luminaires for the road and promenade, positioned to avoid any detrimental impacts to wildlife or cause glare to residential properties.
- 2.4.12 Improved access to beach through the rock revetment will be provided at the existing access points.
- 2.4.13 A central balustrade will be provided between the road and the promenade to improve safety of pedestrian users. This will be in a durable marine grade

material. There will be openings every 100-150m for pedestrian access, which are in line with the current situation.

- 2.4.14 The existing ramp at Heol-Y-Plas junction will be replaced by an accessibility compliant ramp and steps to provide access to the promenade from the adjacent residential areas.

Soft landscape

- 2.4.15 The Proposed Development will introduce raised planters with vegetation at key nodes and more significant amenity green areas around the northern car park. The proposed vegetation will be adapted to the saline and wind-swept environment and include those native to the UK and local area such as the sand dunes.
- 2.4.16 There is the potential to improve the biodiversity of the amenity grass verges along the back of the secondary wall and along the residential areas. This is being proposed as an enhancement which would improve the visual appearance of the area, the biodiversity value and would help to mitigate the visual impact of the secondary wall when looked at from the residential area.

2.5 Surface Water Drainage

- 2.5.1 A drainage strategy report has been developed to demonstrate that there will be no adverse impacts to the existing surface water regime caused by the Proposed Development.
- 2.5.2 It is proposed that the existing surface water drainage is to be retained. The level of the site falls from the base of the secondary wall towards the primary wall. Surface water runs from the back of the existing footway, across the carriageway and adjacent parking bays, towards the existing central wall. Water is then conveyed through the central wall via drainage holes and gaps in the wall for pedestrian access. From there, runoff continues toward the primary wall, where it is discharged through uniformly spaced outlet holes in the wall, and via the slipways adjacent to Heol-Y-Plas and Princes Avenue, directly onto the concrete apron seaward of the primary wall and ultimately discharging into the sea.
- 2.5.3 The Proposed Development proposes to retain the existing holes in the primary wall, providing drainage through the proposed kerb and balustrade, and retaining the outfall regime into the sea. No measures are proposed to change the existing hydraulic control or water quality provisions of the site.
- 2.5.4 The surface water culvert by the café is to be extended through the proposed rock revetment by approximately 15m with scour protection to be considered at the outfall. A non-return valve will be added to the existing surface water culvert through the promenade adjacent to the promenade café.

2.6 Materials

- 2.6.1 The largest volume of materials to be sourced comprises the rock armour (of various grades). The rock is to be a high-quality, sufficiently dense rock such as granite or basalt.
- 2.6.2 At this stage, it is possible that this will be delivered either by road from local quarries or via marine transport, sourced from overseas. The preferred method

is for sourcing by road, however given the uncertainty around availability, price and other impacts at this stage, the possibility of marine deliveries is also included in the assessment. See section 2.12 for further details on the delivery methodology.

- 2.6.3 There will be a requirement for further imported materials i.e. reinforcement, masonry and concrete for the works, but these will be of lower quantities and transport movements. These materials are to be sourced locally and brought in by road to reduce transportation cost, reduce embodied carbon and support local economies. Quantities of materials are shown in Table 2-2.

Table 2-2 Material quantities

Material	Quantity
Rock armour	63,000 t
Sheet piles	950 t
Concrete	5000 m ³
Aggregate	14600 t
Rebar	200 t
Road surfacing	2200 t

2.7 Environmental design measures and enhancements

- 2.7.1 Throughout the development of the design, measures have been embedded to avoid and mitigate impacts. These measures are included below.
- 2.7.2 The existing groynes are known to be partially colonised by blue mussels (a priority species designated under the Environment Act) (see ES Volume 2, Chapter 6 Biodiversity and Protected Sites for more information). The groynes are not required as part of the Proposed Development and are to be removed.
- 2.7.3 Enhancement and mitigation measures have been identified (as described further within ES Volume 2, Chapter 6 Biodiversity and Protected Sites) to include:
- Removal of Japanese knotweed (an Invasive Non-Native Species, (INNS)) to improve underlying habitat conditions
 - Sand dune enhancement (off-site)
 - Expansion of the Sabellaria alveolata reef (off-site) by providing suitable substrate
 - Installation of rock armour lower in the intertidal zone to increase habitat availability for blue mussels and other species

2.8 Design Life

- 2.8.1 The Proposed Development has been designed in accordance with the Design Manual for Roads and Bridges (DMRB). Design working life for new structures is in line with Table 2-3. Structures including flood walls and sheet piles will be designed to a working life category 5, with any departures to be agreed.
- 2.8.2 The proposed design life for each asset is summarised in Table 2-4.

Table 2-3 Extract from DMRB CD 350 table 7.1

Design working life category 1 (temporary structures, typically 10 years design working life)	
Temporary structures ⁽¹⁾	
Design working life category 2 (replaceable structure parts, typically 50 years design working life)	
Expansion joints	Waterproofing systems
Safety barriers	Parapets
Design working life category 3 (Short term structures, typically 50 years design working life)	
Lighting columns	Environmental barriers
CCTV masts, high mast lighting	Sign and signal gantries
Columns for traffic signs/signals	Bridge gantries, access systems
M&E installations	
Design working life category 4 (typically 51-120 years design working life)	
No examples given	
Design working life category 5 (typically >120 years design working life)	
Bridges	Retaining walls
Tunnels	Buried structures
Bridge bearings ⁽²⁾	
(1) Structures or parts of structures that can be dismantled with a view to being re-used are not be considered as temporary.	
(2) The design working life of bridge bearings can be reduced to 50 years subject to agreement with the technical approval authority (TAA)	

2.8.3 The existing structure comprises numerous elements which have been modified, strengthened and repaired throughout its life to date. As-built and condition records of the original structure and any modifications are limited. A risk-based approach will estimate residual design life of retained existing elements with associated assumed requirements for monitoring and maintenance.

2.8.4 Continued maintenance, inspection and repair of the structure will be crucial in ensuring the ongoing performance of the structure and the performance of individual elements. Therefore, a supporting management plan to monitor and maintain the rate of deterioration, hence reducing the likelihood of a catastrophic failure will also be developed by Arup post planning application.

Table 2-4 Proposed asset design life

Asset	Proposed design life
Concrete revetment – new sheet pile cut-off	100 years
Rock revetment	50 years (overtopping) 200 years (start of damage)
Primary wall	As existing
Secondary wall	Walls and bases 120 years Joint sealants 10 years
Flood gates	Flood gate itself 60 years Seals and other parts 15 years

Asset	Proposed design life
Culvert non-return valves	25 years
Public realm hard landscape	Will vary for different products and materials, but will aim for robust materials to maximise design life and maintenance requirements
Public realm soft landscape	
Highway and drainage	40 years
Handrails	25 years

2.9 Operation, Maintenance and Inspection

- 2.9.1 An operation and maintenance plan is to be produced. Given the need to provide coastal flood protection up to 2075, maintenance provisions will be made up until this date. To reflect the planned change to managed realignment after this date, maintenance will be subject to monitoring.
- 2.9.2 Flood gates will be manually operated when a sufficiently large storm event (caused by high water levels, wave action or climatic conditions) is predicted (generally via flood warnings from NRW) and reopened once the event is complete and any flooding has receded.
- 2.9.3 The flood gates will allow for safe operation of the gate by a single operator in windy weather, avoiding use of complex systems such as hydraulics where possible. They will be operable from the 'wet' side given the plan for their operation. It is expected that gates will be closed for a matter of hours, giving time for the promenade to be cleared in advance of a storm, and then to drain down (expected to take a maximum of three hours).
- 2.9.4 Maintenance access will be provided for the flood gates through adjacent on street parking.
- 2.9.5 The frequency of operation will increase over time with climate change.
- 2.9.6 All coastal flood defence assets will be inspected annually. Where maintenance of the rock revetment is required, this is likely to involve similar land-based plant to construction (described in section 2.12.2), to reshape individual elements of the proposed rock revetment to match the construction details where they have been knocked out of place from severe storm events. Access would be via the access ramps located to the north and south of the beach, with any materials likely to be delivered through the routes described in section 2.12.32. Maintenance is more likely to occur after large storm events. The proposed maintenance regime is summarised in Table 2-5.
- 2.9.7 The hardstanding landscape assets materials and products will be robust against vandalism. The products selected will have varying design life and maintenance requirements, as outlined by manufacturers. The period for establishment of soft landscape vegetation by the landscape contractor prior to handover to the council is to be agreed.

Table 2-5 Proposed asset maintenance regime

Asset	Maintenance by Asset Owner
All coastal flood defence assets	Inspected annually, maintenance where required from unexpected damage
Primary wall	Periodic replacement of sealant.
Secondary wall	Periodic replacement of sealant.
Flood gates	Annual testing Periodic replacement of seals.
Culvert non-return valves	Annual maintenance.

2.10 Decommissioning

- 2.10.1 The Proposed Development is being designed to provide a standard of protection to 2075, in line with the Shoreline Management Plan. However, structural elements will be designed with a design life as set out in section 2.8. Given the health and safety risks that would be created should they be removed, it is that the defences will remain in place past 2075 and not decommissioned.
- 2.10.2 Potential decommissioning effects of the Proposed Development have therefore been scoped out of the ES and not considered within the assessments as the coastal defence will remain in place past the design life.

2.11 Construction Programme

- 2.11.1 Works are scheduled to commence in April 2027 and due to be completed in spring 2029, taking approximately 24 months. The estimated timescale for each asset's construction is detailed in Table 2-6.

Table 2-6 Construction programme for key assets.

Asset	Programme
Beach and rock revetment	12 months
Primary wall, central balustrade and secondary wall	12 months
Public realm works (hard and soft landscape)	12 months

- 2.11.2 Barmouth is a popular holiday destination; to minimise negative impacts of the Proposed Development on the community and tourism, the construction programme will be dependent on the tourism season. Programming of activities will take into account impact on local businesses and tourism, aiming to reduce disruption during the summer holiday season. Construction durations, estimated in Table 2-6, are weather dependent. Due to the tidal nature of the site and frequent overtopping experienced it is likely that construction will be disrupted during named storms in the Barmouth locality.

Working hours

- 2.11.3 Regular working hours are scheduled to be between 07:00 and 19:00, although much of the construction work subject to beach access will require variations around tidal patterns. There will be no work over Christmas, New Year, Easter and Bank Holidays. The outline construction methodology estimates that 50 full-time staff will be on site for the duration of the construction: 15 office staff and 35

construction workers. No nighttime working will take place however in the winter months, work will likely start and finish in the dark due to shorter daylight hours.

- 2.11.4 Works will not be carried out during the school summer holidays to reduce impacts on the community and tourism. This has been the case with other construction projects in Barmouth.

2.12 Construction Phase

- 2.12.1 The construction approach to each asset of the Proposed Development is described within this section.

Rock Revetment

- 2.12.2 Stockpiles will be used to store excavated material and imported rock, their location is dependent on the delivery method. There are two options for delivery – Option 1 by road and Option 2 by sea - detailed below, including different stockpile locations to be utilised for each option.
- 2.12.3 For both options, temporary stockpiles located on the beach below MHWS will be used to store rocks for the rock revetment prior to placement. All sand/shingle excavated from the beach will be stored on the beach above MHWS to be later reinstated along the beach and used for beach recharge.
- 2.12.4 The rock revetment will be constructed with one working front, starting in the north and moving south.
- 2.12.5 To construct the rock revetment existing shingle and sand in the footprint of the proposed rock revetment (estimated 9,500m³) will be excavated using a 35t-40t excavator. Shingle and sand will be moved to an on-site stockpile location using a dump truck. Any non-indigenous material or non-natural debris will be removed and disposed of at a nearby tip. A geotextile separation membrane will be placed on the excavated surface. Rocks will be individually placed from the temporary stockpiles on the beach with a 50t excavator with a grab. This work will be undertaken at low tides.

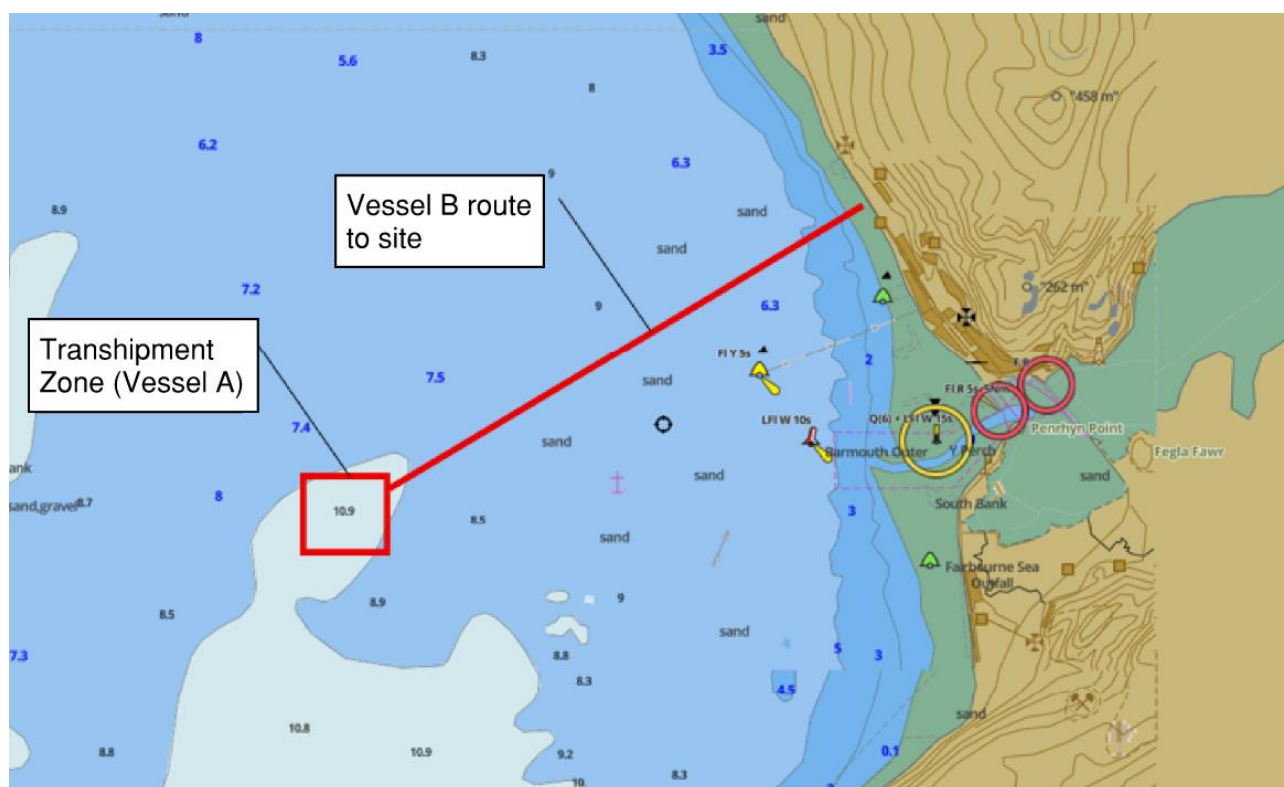
Option 1 - Delivery by Road

- 2.12.6 For option 1, the main stockpile area will be located within the site compound area (see paragraph 2.12.31) to store 7000t-10,000t of rock for the rock revetment. Rock will be moved from the main stockpile to temporary stockpiles below MHWS prior to placement using dump trucks and a 50t excavator with a grab.
- 2.12.7 For option 1, delivery by road, the rock would be supplied by a Welsh quarry. The approximate volume of rock required for the Proposed Development is 63,000t, which if delivered by road would equate to around 20 round trips per day over a period of 10 months using heavy goods vehicles (HGVs).
- 2.12.8 Graphic 2-5 indicates the site compound area and construction access routes. Temporary stockpile areas will be adjacent to the beach access ramps (below MHWS). All other material will be stored above MHWS in the site compound area.

Option 2 - Delivery by Sea

- 2.12.9 For option 2, delivery by sea, the rock will be transferred onto the shore below MHWs level as a temporary stockpile, rock will be placed directly from here to the rock revetment footprint.
- 2.12.10 The rock is likely to be sourced from a European quarry. The rock supplied will be transported to the quayside where approximately 25,000t of rock will be loaded onto a Self-Discharging Excavator Vessel (SDEV) (Vessel A). Vessel A will set sail to the site where it will anchor approximately 6km offshore of Barmouth for around 1 to 2 weeks before setting sail for another load.
- 2.12.11 A shallow draught tipper boat or smaller barge (Vessel B) of capacity 1,000-3,000t will travel with Vessel A and the rock armour will be transferred individually from Vessel A onto Vessel B using an on-board excavator equipped with a hydraulically operated grab. Vessel B will transport the rock to the site of the proposed rock revetment at high tide and transfer the rock onto the seabed. At low tide this will be sorted into sizes and placed in the rock revetment footprint using the excavator and grab. See Graphic 2-2 for suggested anchoring site and route of Vessel B between Vessel A and the site of the Proposed Development.

Graphic 2-2 Suggested location of Vessel A anchoring site and Vessel B route to site.



- 2.12.12 Vessel B will shuttle to and from the main ship transferring rock to the breakwater site. It is estimated that 10-20 journeys to and from the main ship will be required per load. Once Vessel A has been unloaded, it will return to collect more rock from the quarry. A total of up to 4 return trips for Vessel A are estimated to be required to transport the rock.
- 2.12.13 Navigational safety and lighting will be required for some of the works below high water. The proposed works to the rock revetment will be limited to daylight hours 'in the dry' i.e. during low tides only. This will prevent interference with

harbour navigation access. Vessels will be lit and marked appropriately conforming to relevant navigational code, including the Maritime and Coastguard Agency (MCA) requirements. The harbourmaster will be notified of the dates of works, in advance. There would be one or two tugs on site for barge handling and control of Vessel B. Upon delivery, Vessel B will approach the shoreline shortly before the following high tide. Some vessels will be running their engines when offloading is taking place. Marine Gas Oil (MGO) will be used as fuel. At no time will there be any beaching of boats on the beach.

- 2.12.14 In the unlikely event of an emergency the Harbourmaster will be contacted so that a Notice to Mariners can be raised and / or lighting or buoying installed if required to limit further damage, nuisance or incidents occurring. In the unlikely event that plant becomes trapped and has to be abandoned, the harbourmaster will be alerted, so that a notice to mariners can be raised. Depending on location and if deemed necessary, requirements to mark or light the obstacle until it is removed can be agreed with the harbourmaster. Conditions of contract will be placed to ensure that the contractor is responsible for the removal of any obstructions to navigation caused by abandoned plant.

Beach Access Steps

- 2.12.15 Sheet piles will be placed either side of the area where the steps will be constructed reaching a height above MHWS, this will be carried out using a 70t piling rig. Shingle/sand will be excavated using a 35t-40t excavator and moved to a stockpile area on the beach above MHWS with dump trucks. Rubble will be placed between the two sheet pile walls and steel framework constructed to support the steps. Precast concrete slabs and steps will be placed on top of the steel frame to form the steps and landings using a 70t crane with a maximum lifting height of 55m. The sheet piling will be cut down to follow the line of the concrete steps and a concrete capping beam cast in situ. A 30m concrete pump will be used to pour concrete from a concrete mixer truck parked on Marine Parade.

Beach Access Ramp

- 2.12.16 The construction methodology of the ramp is similar to the access steps. The existing ramp will remain in place and the proposed ramp constructed on top and around the existing concrete structure. Sheet piles will be placed on either side of the proposed ramp footprint with bedding rock and loose rock infill between the sheet piles. A geotextile layer with concrete blinding layer will be poured over the fill material to create a smooth surface at the correct gradient. A precast concrete base slab is to be placed on top of this and form a connection with the sheet piles. Bulk concrete pour anchored into the existing ramp will raise the level of the top section of the existing ramp to join the new ramp. The top level of concrete parapets is to remain above the top of the rock revetment and a balustrade railing on top. The concrete parapet is designed to prevent the public from walking along the top of the wall. Rock revetment will be placed around the ramp and over the existing ramps, partially embedded in mass concrete to reduce risk of units shifting.

Concrete Revetment - Sheet piling

- 2.12.17 New sheet piling will be installed using 70t piling rig and a crane with a maximum lifting height of 55m.

Primary wall

- 2.12.18 Localised concrete repairs and filling of joints will be carried out using hand tools where required – isolated sections of the promenade would need to be cordoned off while this is carried out.

Central Balustrade

- 2.12.19 The central balustrade will be constructed by demolishing the existing masonry wall, excavating the promenade surface and reconstructing the kerb and balustrade. Two gangs will begin in the south separated by a small gap and move north to increase efficiency. The balustrade will be built in sections of up to 5m to reduce disruption and traffic management required. Street furniture such as signage and benches will be removed and stored to be replaced following construction. Traffic management measures will be required as work will take place on and adjacent to the west lane of Marine Parade (see section 2.12.33).
- 2.12.20 The existing wall will be demolished using an angle grinder, pneumatic breaker, excavator and dump trucks. The waste material will be transported offsite for disposal. Kerb and balustrade units would be transported from the compound, along the promenade, using lightweight tractor and trailer units. Lifting equipment will be used to lift the units into place and connection details will be completed by hand.

Secondary Wall

- 2.12.21 Construction of the secondary wall will involve demolition and reconstruction of the existing wall. Two gangs will begin in the south separated by a small gap and move north to increase efficiency of the crane and other equipment. The wall will be built in 5m sections to reduce disruption and traffic management required. Street furniture such as signage will be removed and stored to be replaced following construction of the secondary wall. Traffic management measures will be required as work will take place adjacent to the east lane of Marine Parade.
- 2.12.22 The existing wall will be demolished using an angle grinder, pneumatic breaker, excavator and dump trucks. The waste material will be transported offsite for disposal. Excavation of the existing wall foundations is not required due to the use of sheet piles. Sheet piles will be lifted using a crane and driven using a piling rig to construct the wall's foundations.
- 2.12.23 The concrete recurve wall will be constructed on top and connected to the sheet piles. This is likely to be constructed in-situ with concrete brought onto site and poured into formwork, although the use of precast units may be possible. On the landward side the wall will be clad with stone masonry to match the existing secondary wall.

Groyne Removal

- 2.12.24 The timber groynes will be removed using hand cutting tools and machinery at low tide. Groyne piles will be removed using an excavator with a grab or chain attachment. Concrete steps attached to the existing concrete revetment at the end of each groyne will be broken out with an excavator and a breaker. Waste material from the groynes and steps will be removed from site using dump trucks. Groyne removal will take approximately two weeks.

Outfall Extension

- 2.12.25 The existing surface water outfall will be extended through the rock armour to provide a new outfall. The outfall is likely to be extended in the same pipe material, with concrete surround for protection. The pipes will be lifted into position with an excavator, and shutters placed around the pipes prior to pouring concrete using a mobile concrete pump. A proprietary flap valve will be fixed to the end of the encased pipe.

Demountable Defences

- 2.12.26 Temporary demountable flood defences would be installed where existing flood defence features are temporarily removed as part of construction, prior to the construction of the permanent works.

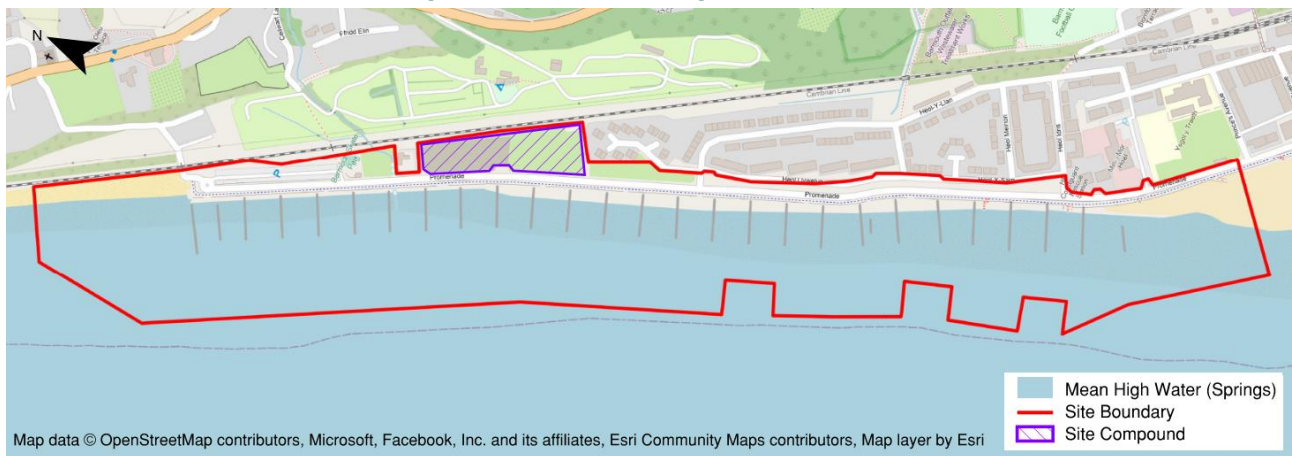
Construction Lighting

- 2.12.27 Throughout the duration of the project, temporary lighting will be required to allow works to continue outside of daylight hours, this will mainly occur during the winter months. This includes work lighting which will be temporary lighting installed in the same place throughout the project and task specific lighting which will be in place for specific sections of the works for a shorter length of time. All temporary lighting will be directed away from the sensitive areas identified by the Ecological Clerk of Works (ECoW).
- 2.12.28 Flood lighting, security lights, and any other obtrusive external lighting shall be sensitively located to avoid nuisance to neighbouring properties and should only provide the necessary luminance for the relevant tasks. Site compound lighting will be installed to light up compound walkways and access, and directed into the site compound causing no disturbance to the local environment outside of the compound.
- 2.12.29 Work lighting locations:
- All cabins in the site compound.
 - Stockpile area in yard.
 - On ramps for unloading/turning around for deliveries.
 - Along any working area (on the beach or top of the promenade).
- 2.12.30 Types of task specific lighting:
- Mobile Tower lights.
 - Hand held lighting & Head torches.
 - Vehicle and Plant lighting.

Site Compound and Access

- 2.12.31 The construction compound will be located on privately owned land to the east of Marine Parade as shown in Graphic 2-3. Arrangements have been made with the landowner for use of the land during the construction period. The compound will accommodate welfare, office and parking facilities.

Graphic 2-3 Site compound location



Vehicle routes to site

- 2.12.32 Vehicles will access the site from the south following the route marked in Graphic 2-4. Due to height restrictions at other railway crossing points this is the most suitable route for HGVs and it is therefore necessary to pass through the town centre.

Graphic 2-4 Planned vehicle route to site.



Traffic management & access

- 2.12.33 Access from the compound to the beach will be via existing ramps or via a purpose-built ramp. Existing ramps will require strengthening or minor improvements (widening, edge protection, pedestrian access) to facilitate access and they will eventually be rebuilt to access the beach through the new revetment works.
- 2.12.34 The works will be carried out under a combination of two traffic signals and priority works installed along Marine Parade to maintain access to all properties at all times.
- 2.12.35 It has been assumed that all staff will arrive and depart from the site during the typical highway peak hours of 08:00-09:00 and 17:00-18:00.
- 2.12.36 Based on the assessment of the lack of existing public transport provision, it has been assumed that 50% of staff will drive to work in their own cars, and 50% will be passengers in a company van.
- 2.12.37 Innovative traffic monitoring (Tactical Road User Surveillance Technology) and management (Dynamic Roadspace Utilisation Management) systems will be used to optimise traffic management by adapting to traffic conditions in real time.

Abbreviations List

AGC	Alun Griffiths Contractors
D&B	Design and Build
ECI	Early Contractor Involvement
EIA	Environmental Impact Assessment
ES	Environmental Statement
FAS	Flood Alleviation Scheme
OBC	Outline Business Case
YGC	Ymgynghoriaeth Gwynedd Consultancy