Appendix L – Water Framework Directive Assessment

Aberaeron Coastal Defence Scheme

Water Framework Directive Assessment

Ceredigion County Council

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Notice

This document and its contents have been prepared and are intended solely as information for Ceredigion County Council and for use in relation to the Water Framework Directive (WFD) assessment for the Aberaeron Coastal Defence Scheme

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1. Introduction

1.1. Background

Atkins has been commissioned by Ceredigion County Council (CCC) to develop a coastal defence scheme for the town of Aberaeron located in Ceredigion, Wales, to reduce coastal flooding. The scheme is known as Aberaeron Coastal Defence Scheme (herein referred to as 'the Scheme') and a figure showing the general arrangement is contained in Section 1.1 (Figure 1-1).

This document presents the Water Framework Directive (WFD) compliance assessment for the Scheme. The aims of the document are to:

- Provide background information on the WFD legislation and the proposed works;
- Provide a high-level baseline understanding of the affected water bodies in the context of the WFD;
- Provide an assessment of the potential for the proposed works to cause deterioration in the WFD status of any water body directly or indirectly affected by the works; and
- Provide an assessment of the potential impacts on water body improvement measures and the ability to meet WFD objectives, as well as to suggest control measures where necessary.

1.2. Need for the Scheme

Aberaeron is situated around Aberaeron Harbour, the mouth of which is marked by two piers, with South Beach and North Beach on either side of the piers. The River Aeron runs through the town and discharges into the harbour. Residential and commercial properties are located around the harbour and to the rear of the beach.

Aberaeron has a long history of flooding from a combined risk of flooding and erosion. With climate change and the predicted rises in sea levels, storms and flooding will continue to increase in frequency and severity. Low-lying areas of Aberaeron are at risk of flooding generated by extreme tidal waters and wave overtopping from the harbour, and areas to the rear of South Beach are at risk of flooding resulting from beach erosion. The layout of the harbour entrance is such that during a north-westerly storm event, waves travelling across the Irish Sea are able to easily propagate into the harbour. The existing piers at the mouth of the harbour offer little protection from these large waves. During a storm event coupled with heavy rain, water levels also rise in the River Aeron, raising water levels in the harbour even further as the river tries to discharge into the sea against strong incoming waves.

Engineering works were carried out at North Beach in 2009, which included the replacement of existing timber groynes, new rock groynes, a beach nourishment programme, reconstruction of the sea wall and construction of a rock revetment along the North Beach. These works have provided improved protection to the northern part of the town from overtopping inundation from the sea, increasing the level of flood protection to a 1 in 200 year event, or 0.5% Annual Exceedance Probability (AEP).

Despite the improvements to flood risk management in the northern part of the town, parts of Aberaeron have continued to experience flooding; particularly in the harbour area (around Quay Parade, Pwll Cam and in the area between the Monachty Hotel and the A487 road bridge) and at South Beach (along Beach Parade and at the Aberaeron Yacht Club). Most recently, flooding occurred in 2017 during Storm Brian and in 2018 during Storm Callum, which caused a record increase in fluvial water levels along the River Aeron and led to property flooding and the loss of eight boats in the harbour through capsizing. The flooding is caused by waves entering the harbour, and wave overtopping of the harbour walls and shingle ridge on South Beach.

The harbour is currently only afforded protection by the two piers at the mouth of the harbour as well as from a flood wall along Quay Parade, which is set back from the edge of the quayside wall. Further into the harbour near the A487 road bridge, flood walls are located on both banks of the River Aeron.

Modelling results have indicated that the existing flood wall along Quay Parade has a present day 1 in 5 (20% AEP) standard of protection against wave overtopping. The current level of protection provided by the wall is predicted to reduce over time with climate change, rising sea levels and increased intensity of storms.

Furthermore, the flood wall is not continuous around the harbour. Although the two piers offer some shelter to the harbour, they do not provide enough protection from present day storm events, with waves able to overtop the structures and penetrate directly into the harbour. The South Pier in particular is in a significant state of disrepair and at risk of imminent collapse. The groynes along South Beach are also in poor condition and are predicted to collapse in the near future (within one to three years). Further loss of the rock revetment is predicted between five to 15 years. The loss of coastal defences along South Beach would result in the loss of shingle beach, and consequently, more regular flooding is predicted to occur as water inundates via Beach Parade.

The predicted loss of the existing coastal defences as well as the limited flood defences within the harbour, highlights the need for the Scheme in order to protect the harbour, town and South Beach from flooding and storm damage.

1.3. Site Description

The Scheme is located in Aberaeron (NGR SN 45627 62917). Aberaeron is situated on the west coast of Wales in Cardigan Bay, approximately 30km south of Aberystwyth. This area is characterised by the presence of two and three-storey terraces of brightly coloured rendered houses of similar and sympathetic architectural style laid out on a grid-plan, with the occasional landmark building such the Harbourmaster Hotel and the Town Hall.

The main harbour lies directly at the mouth of the River Aeron with many boats beached in the harbour during low tide. In the north-east corner of the harbour is a smaller, contained harbour (Pwll Cam) in which water is maintained several feet deep by a sill where shallow draft boats are moored to the harbour wall.

Much of Aberaeron town is centred around the harbour, with the coastal frontage split into North and South Beaches either side of two piers, which protect the harbour entrance. The two piers, North and South pier, extend from the harbour entrance at the end of the associated quays. The seaward end (head) of South Pier is currently fenced off due to it being unsafe for use and in need of repair. There is a crib groyne at the base of South Pier which is in a state of disrepair.

South Beach is a mixed shingle and sand beach, with shingle on the upper beach, and sand on the lower beach. North beach is of similar topography, but with the addition of mussel beds and *Sabellaria* reef assemblages. There are six timber groynes along South Beach in varying states of repair, and a rock revetment along the upper beach. North Beach also consists of groynes and rock revetments which are in better condition due to the engineering works carried out in 2009 as discussed above.

To the south of the Harbour, an area of open land adjacent to CCC's offices is proposed to be used as the construction compound.

The Scheme is also located partially within the boundary of the following statutory nature conservation designations:

- West Wales Marine Special Area of Conservation (SAC)
- Cardigan Bay Special Area of Conservation (SAC)
- Aberarth - Carreg Wylan Site of Special Scientific Interest (SSSI)

The extent of the Scheme boundary is shown in Figure 1-1.

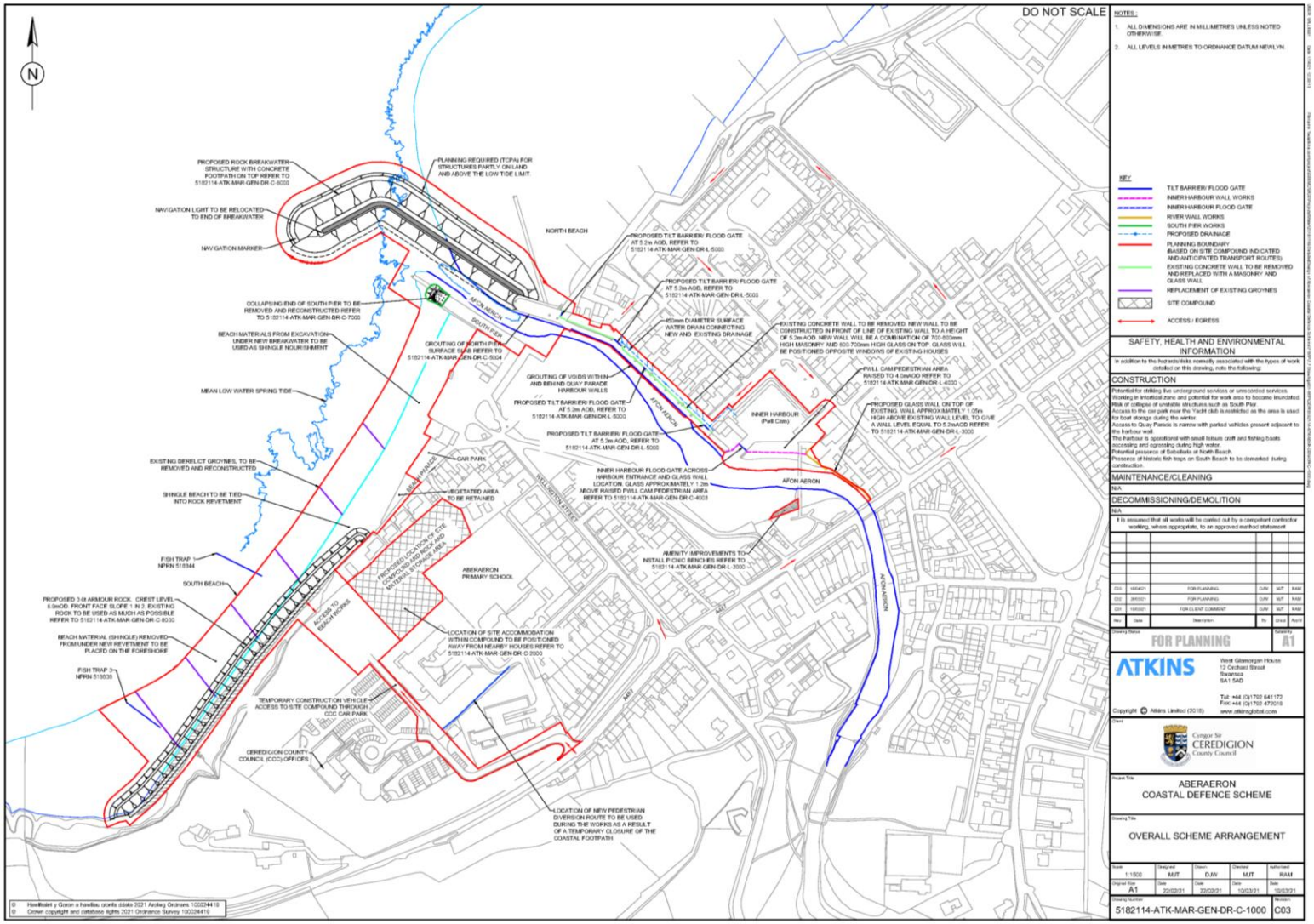

Figure 1-1 Aberaeron Coastal Defence Scheme

2. Methodology

2.1. The Water Framework Directive – Legislative Background

The Water Framework Directive (WFD) originates from the EU but has been retained in UK law following the UK's exit, via The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, as amended. For the purposes of this ES, the legislation will be referred to as the WFD throughout this document, with the assessment of the Scheme in relation to the Water Environment Regulations referred to as a WFD Assessment (some industry practitioners may start referring to it as a Water Environment Regulations Assessment). The Water Environment Regulations (referred to herein as the 'Regulations') applies to all coastal and estuarine waters in Wales, to a distance of 1 nautical mile (nm). Under the Regulations, any activity or project with the potential to have an impact directly or indirectly on water body ecology will require a 'WFD Assessment'. A WFD Assessment will consider whether the activity or project has the potential to cause deterioration in the ecological status or ecological potential of that water body or adjacent water bodies. The WFD Assessment also considers the biological, physico-chemical and hydromorphological qualities of a water body.

The framework for delivering the WFD is through a series of River Basin Management Plans (RBMPs), which requires surface water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES)[1], and for groundwater bodies to achieve both Good Chemical Status (GCS) and Good Quantitative Status (GQS). The RBMPs outline the actions required to enable natural water bodies to achieve this. Artificial and Heavily Modified Water Bodies (A/HMWB) are surface water bodies that may be prevented from reaching GES due to the modifications necessary to maintain their function for essential human uses, such as flood defence, navigation or drinking water supply. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of mitigation measures outlined in the RBMP.

New activities and schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to a deterioration in water body status. They may also render proposed improvement measures ineffective, leading to the water body failing to meet its objectives for GES/GEP. Under the WFD, activities and schemes must not cause deterioration in water body status or prevent a water body from meeting GES/GEP by invalidating improvement measures. A summary of key WFD objectives is presented in Figure 2-1.

In addition to protecting and improving water bodies, the WFD also require that a register of 'Protected Areas' is developed, which are "all areas lying within each river basin district which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water". In the United Kingdom, these Protected Areas are:

- Areas with water-dependent habitats that are protected under the Birds and Habitats Directives, and (by Government policy) under the Ramsar Convention;
- Drinking Water Protected Areas;
- Shellfish Waters;
- Bathing Waters;
- Nutrient Sensitive Areas.

The potential impacts of new activities and schemes on these protected areas must also be considered in order to ensure compliance with the overall requirements of the Regulations.

[1] The WFD classification scheme for GES includes five categories: high, good, moderate, poor and bad. 'High status' means no or very low human pressure. 'Good status' means a 'slight' deviation from this condition, 'moderate status' means 'moderate' deviation, and so on.

WFD Objectives

The WFD is a European Directive transposed into UK law which sets out a strategic planning process for the purposes of managing, protecting and improving the water environment. The main objectives of the WFD are to:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- Aim to achieve at least 'Good Status' for all waters by 2015 (2021 or 2027) where fully justified within an extended deadline under Article 4.4;
- Promote sustainable use of water;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Help reduce the effects of floods and droughts.

Natural Resources Wales are responsible for implementing the WFD in Wales, with the Environment Agency having joint responsibility for cross-border areas. They monitor, advise and manage many aspects of the water environment through regulating discharges, abstractions and processing environmental permits and licences. Natural Resources Wales and the Environment Agency are committed to implement environmental improvements by reducing the physical impacts of flood risk management activities within artificial or heavily modified water bodies.

WFD Classification

The WFD classification for a defined water body is produced by the assessment of a wide variety of different 'elements' which includes:

- '*biological elements'* such as fish, invertebrates, Phytobenthos (which includes plants, macro-algae, phytoplankton);
- '*supporting elements*' that include chemical measurements such as ammonia, dissolved oxygen, pH, phosphate, copper, zinc and temperature; and
- '*supporting conditions*' (sometimes referred to as hydromorphology) that assess the physical attributes of the water body such as 'quantity and dynamics of flow' and 'morphology'.

The assessment given for each element is also accompanied by a measure of certainty in the result. The status classification is published in the RBMP and provides a baseline condition against which compliance and future improvements can be measured.

WFD Compliance

There are three key objectives against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

- Objective 1: The Scheme will not cause a deterioration in any element of water body classification.
- Objective 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Objective 3: The Scheme will contribute to the delivery of the relevant WFD objectives. In this case, it will be what contribution the scheme can make towards the water body reaching its objective GEP through planned RBMP mitigation measures.

Objective 1 and Objective 2 must be met to avoid infraction of the WFD. The delivery of the third objective is central to the implementation of the WFD, where it can be supported through its operational activities. If it is considered that the Scheme is likely to cause deterioration in water body status or prevent a water body from meeting its ecological objectives, then an assessment would be made against the conditions listed in Article 4.7 of the WFD. Article 4.7 can be invoked if; 'new modifications' are of overriding public interest and/or the environmental and social benefits of achieving the WFD objectives are outweighed by the benefits of the new modifications to human health, safety and sustainable development; there are no significantly better environmental options that are technically feasible or not disproportionately costly; and all practicable steps for mitigation have been taken.

Figure 2-1 Background to WFD Assessments

2.2. Approach to the WFD Assessment

2.2.1. 'Clearing the Waters for All' guidance

Natural Resources Wales (NRW) is the lead authority for the implementation of the WFD in Wales, whereas, the Environment Agency (EA) is the lead authority for the WFD in England. The EA has developed guidance to support carrying out WFD assessments for new schemes in estuarine and coastal waters - "Clearing the Waters for All" (Agency, 2016), published on www.gov.uk. This guidance can be utilised in WFD assessments in Wales and is applicable to activities in the marine environment up to 1 nautical mile out to sea. This guidance recommends a three-staged process to the WFD Assessment, comprising:

- Screening – to exclude any activities that do not need to go through the scoping or impact assessment stages;
- Scoping – to identify the receptors that are potentially at risk from the proposed activity and need impact assessment; and
- Impact assessment – considers the potential impacts of the proposed activity, identifies ways to avoid or minimise impacts, and shows if the activity may cause deterioration or jeopardise the water body achieving good status.

The guidance also recommends that all activities are considered, including each relevant stage (e.g. construction, operation and decommissioning), and that all waterbodies that could both directly and indirectly be affected by the activities are included.

This WFD assessment has broadly followed the principles outlined in the 'Clearing the Waters for All' guidance.

2.2.2. Data Sources

A number of surveys and assessments have been carried out to inform the development of the Scheme. Where relevant, the details of these have been used to inform this WFD assessment. Online sources of information have also been used. The key data sources that have informed this assessment are:

- Current WFD status classification data from Water Watch Wales at https://waterwatchwales.naturalresourceswales.gov.uk;
- Data on WFD Protected Areas and WFD Higher and Lower Sensitivity Habitats, Natural England 2021);

  Western Wales River Basin Management Plan 2015-2021 Summary (Natural Resources Wales, 2015);
- Wales Water Body Objectives and measures update 2017 at https://waterwatchwales.naturalresourceswales.gov.uk;
- Numerical Sediment Modelling (Atkins, 2021);
- Beach Nourishment - Comparison of source and target shingle, Atkins 2021; and
- Flood Consequence Assessment (Atkins, 2021a).

2.2.3. Structure and Content of this Report

The structure of this report and a summary of the contents and steps undertaken to complete each section are detailed in Table 2-1.

Table 2-1 Structure of this Report

Chapter	Title	Content and Steps
1	Introduction	Introduces the purpose of the Scheme and the context of its location.
2	Methodology	Describes the legislative context to the assessment and the overall approach, including guidance used and data sources.
3	Proposed Works and Programme	Sets out the outline description of the activities that will be carried out at each Scheme stage, including construction, operation and decommissioning.
4	Screening	Identification of the activities described in Chapter 3 that may impact on the quality elements of WFD waterbodies; and identification of water bodies that are relevant to the Scheme.
5	Scoping	Presentation of the baseline conditions for the relevant quality elements of each water body screened in for assessment, and consideration of the potential risk of deterioration from Scheme activities screened in.
6	Assessment	Detailed examination of and commentary on the risks identified at Scoping, and their potential to result in deterioration of any quality elements. This step includes potential measures that may be used to avoid or reduce the potential magnitude or scale of any effects. The assessment includes consideration of effects on WFD Protected Areas.
7	Conclusion	A summary of the conclusions drawn by the WFD Assessment.

3. Proposed Works and Programme

3.1. Proposed Scheme

The works are centred around the Harbour, specifically the Inner Harbour of Pwll Cam and Pen Cei/Quay Parade, and extend along South Beach and some works taking place to the south of North Beach.

The Scheme comprises five elements, which are interlinked as integral parts to the overall flood defence scheme. The scheme elements are as follows and shown in Figure 1-1.

- Construction of a new rock breakwater extending out from the North Pier.
- Refurbishment and re-building of the pier-head of South Pier including grouting repairs of walls
- Flood wall construction at the following locations:
  - Raising of the existing flood wall along Pen Cei/Quay Parade including grouting repairs of the existing quay wall
  - Raising of the existing flood wall between the rear of Monachty Hotel and the A487 referred to as the River Aeron flood wall
  - New flood wall between Pwll Cam and the Monachty Hotel (and connecting with the existing adjacent flood wall between the Monachty Hotel and A487)
- Construction of a flood gate at Pwll Cam inner harbour.
- Improvements to the existing defences on South Beach:
  - Replacement of existing timber groynes
  - Replacement of existing rock revetment
  - Beach renourishment

The Scheme has a 1 in 200 year design return period for wave overtopping within the harbour, with the rock revetment on South Beach having a 1 in 200 year standard of protection. The Scheme also provides a 1 in 1,000 year standard of protection against extreme sea levels for the design life (100 years) of the Scheme. The design of the Scheme has been carried out in line with the requirements of the Welsh Government for the development of residential areas in relation to flood risk (TAN15, Welsh Government 2004 & 2021), as well as in line with guidance for flood and coastal erosion risk management and adaptation to climate change (Welsh Government, 2021).

3.2. Site Access and Construction Methods

3.2.1. Site Access

The site compound will be located on a grass field in between Ysgol Gyrnadd Aberaeron Primary School and South Beach. A temporary gravel access track will be constructed from the car park of the CCC Penmorfa offices to the compound area. Removal of topsoil and grass will also be required for this operation. Both the site compound and gravel track will be removed following construction, and the area re-topsoiled and grassed/seeded, returning it to its existing condition. The site compound will be used to store construction materials, plant and machinery, site offices and basic welfare facilities for the contractors (self-contained kitchen/toilets).

The site compound will also contain a storage area for diesel and fuels and all refuelling of plant will take place in the site compound. All fuels will be stored and handled in accordance with best practice procedures. The contractor will be required to produce a Construction Environmental Management Plan (CEMP) which will set out an emergency response procedure in the event of a chemical leak or spill. The CEMP will also

include methods for maintaining a tidy site. All staff on site will be briefed on the contents of the CEMP including the emergency procedures before commencing the works. Upon completion, the site compound will be removed and the area reinstated.

Materials for the Scheme, including the site compound units, could be delivered to site by road, sea or both. Materials that could arrive by sea include the rock for the breakwater and revetment and the Pwll Cam flood gate. The exact details are yet to be finalised and will be determined in conjunction with the appointed contractor. Road access to the site will be via the A487, turning onto the unmarked entrance road to CCC Penmorfa offices.

Should delivery of rock for the breakwater and revetment be by sea, the rock is likely to be sourced from a European quarry. The rock would be transported by ship or barge, which will anchor offshore of Aberaeron for a couple of weeks. Rock can be brought ashore by using a shallow draught barge controlled by a small tug to meet the main vessel and the rock will be transferred individually from the main ship onto the barge using an on-board excavator equipped with a hydraulically operated grab. The tug and barge will transport the rock to the site of the breakwater, where rock is left on the beach.

For the harbour wall raising at Quay Parade, materials will be transported from the site compound, along the A487, into Regent Street and follows the one-way system down Tabernacle Street/Market Street and Cadwgan Place and onto Quay Parade. For the wall raising to the rear of the Monachty Hotel and up to the A487 road bridge, access to this area is via the Market Street car park to the north of Pwll Cam.

There will be a need to create a temporary sheet pile cofferdam at the entrance of Pwll Cam to construct the new gate. The flood gate for Pwll Cam may be transported by a barge, pulled into the harbour by tug boat. Liaison will be carried out with the CCC Harbourmaster with regards to the need for preparing a Notice to Mariners informing them of this aspect of the works. Alternatively, the gate might be installed from land and the gate brought in by road. For this, a temporary access road formed of crushed stone materials could be constructed from the slipway and along the eastern dock wall within the Pwll Cam harbour on the dock seabed adjacent to the proposed gate location. In addition, a Notice to Mariners would also be needed for the new breakwater construction and for any delivery of materials arriving by sea.

3.2.2. Construction Method

3.2.2.1. North Pier Breakwater

Before the breakwater is constructed, some excavation of the shingle seabed is required to ‘toe-in’ the outer perimeter of the breakwater below the sea-bed. This will enable the breakwater to be protected from any scour which may arise from large storm waves which might wash out some shingle and undermine the base of the breakwater and to prevent movement from future settlement. The excavation will be carried out using a number of long-reach and 360 degree tracked excavators (see Figure 3-1) positioned on the beach at low tide. Excavation will be carried out at low tide for the sections of breakwater that will be above MLWS. For sections of the breakwater below MLWS, excavation will take place under water. The shingle material removed will be stockpiled above MHWS on South Beach with some of it being re-used in the core of the breakwater and some as shingle recharge on South Beach. The total amount of material excavated is estimated to be 12,916m³ (8,000m^3) is estimated to be used on South Beach as shingle nourishment, and 4,916m^3 in the breakwater core).

Prior to the placement of the breakwater rocks, a geofabric mat will be positioned onto the seabed in the excavated footprint of the breakwater. In addition to helping reduce settlement once the breakwater is constructed, it will also help reduce the washout of bed material beneath the rocks and reduce scour in the future. The mat will be laid on the seabed by a tracked excavator (see Figure 3-2), with rocks placed onto the mat to hold it into position before the rest of the breakwater construction commences.

The rock for the breakwater will sourced from a quarry or number of different quarries, depending on the quantities available and to ensure a constant supply of rock for the scheme. The rock will be transported to site by sea and/or by road. For delivery by road, it is likely the rock would be sourced from a local Welsh quarry, with more than one quarry required due to the volume of rock needed. The rock would be transported to the site compound via the A487. It is estimated that there will be 25 round trips made to site per day over a period of 6 to 9 months using articulated lorries for the larger 6 -10 t rock and tipper lorries for the 0.3 to 1t rock. In between each rock delivery to the site compound, 25t dump trucks (Figure 3-4) will transport the rock from the stockpile in the site compound to the breakwater location, thus maintaining space

in the compound for more rock to be delivered. There will be stockpiles of rock temporarily placed on the beach to organise the rock into sizes and due to tidal working.

The rock will be transported from the site compound to South Beach via dump trucks which will use a temporary access ramp formed out of rocks leading from the site compound onto the beach. These dump trucks will then transport the rock along South Beach to the breakwater. The transportation of rock from the site compound to the stockpile areas will continue for approximately 6 - 9 months (movement of approximately 6no. 20t dumpers per day). The dumpers will be required to reduce their footprint on the beach by keeping vehicle movements to the upper beach area and avoiding the intertidal area as much as possible to reduce sediment becoming mobilised into the water and increasing turbidity. Although South Beach forms part of the SSSI and there is a high presence of *Sabellaria alveolata* along the coastline, generally this habitat is absent from the intertidal area at South Beach.

The rocks will be picked up from the stockpile area by a long reach 360 excavator (35-40t) with a grab (see Figure 3-3) attachment to carefully pick up and place the rock. These will be located on the beach for the breakwater construction. For the smaller core rock, dump trucks will be used to tip the rock on top of the geofabric layer and assisted by excavators to spread the rock material. It is likely that the breakwater will be constructed starting from the landward end and progressing seaward. This will allow machinery constructing the parts of the breakwater in the subtidal zone to work from the top of the newly constructed portions of the breakwater.

For delivery by sea, 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 barge. The barge vessel will set sail to the site where it will anchor offshore of Aberaeron for around 1 to 2 weeks before setting sail for another load.

A shallow draught tipper boat or smaller barge of capacity 1,000-3,000t will travel with the main vessel and the rock armour will be transferred individually from the main ship onto the tipper boat or barge using an on-board excavator equipped with a hydraulically operated grab. The tipper boat will transport the rock to the site of the breakwater or South Beach at high tide and tip the rock onto the seabed. At low tide this will be sorted into sizes and placed in the breakwater footprint using the excavator and grab.

At no time will there be any beaching of boats on the beach. The tipper boat or barge 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. Once the main ship has been unloaded, it will return to collect more rock from the quarry. A total of up to 4 return trips are estimated to be required to transport the rock.

At the end of the existing North Pier, the existing concrete wave wall will be removed to enable access for construction machinery onto the pier. Demolition of the wall will be carried out using a back-hoe excavator and breaker to break out the concrete, with the material removed off site to a licenced tip. The material is likely to be removed via Quay Parade.

Before completing the breakwater construction, a concrete walkway will be constructed along the full length. Pre-cast concrete ‘u’-shaped units will be manufactured in a factory offsite and transported directly to North Pier via Quay Parade, using 8m long trucks with 2 concrete blocks per truck. It is estimated that there will be 4 deliveries to site per day over a period of 1 month, approximately 100 round trips.

The concrete ‘u’-shaped units will be positioned on the top of the breakwater with a mobile crane and concrete will be poured into the precast units using a concrete pump and concrete delivery lorries. Rock armour will be placed around the precast units to secure them in place. The surface of the concrete blocks will be left exposed to form a concrete footpath on top of the breakwater. This footpath will provide access for recreation as well as for future maintenance of the structure.

Repair work to the surface slab will be undertaken at the end of the existing North Pier. This will involve vertical drilling and grouting which will take place from the surface of the pier. Holes measuring 35mm will be drilled down into the top surface of the pier to a depth of 5m. The holes will be drilled in a staggered diamond shape pattern at a distance of 1m north to south and 2m east to west. The holes will be injected with a combination of lime and cement grout to stabilise the loose ground beneath the surface slab.

Signage and navigation markers (including electricity cables for navigation lights) will also be installed. Existing life rings are present on North Pier and the need for any additional life rings/buoys will be determined by CCC.

3.2.2.2. South Pier Refurbishment

The seaward end of the South Pier will be demolished using machine mounted breakers, grabs and hand tools. Machinery and equipment will be located on the beach. Sections of concrete, masonry and other arisings will be removed from site by dumpers. There is the potential for some of the masonry to be salvaged and recycled. The demolition work will take place during low tides for ease of access by the contractor. Working at low tide will help to reduce the amount of debris falling into the water. To further reduce this, a geotextile layer, or similar, will be placed on the seabed to help capture falling debris for removal from site before the tide rises. The contractor may also decide to build a level temporary working platform at the base of the pierhead, which is built out of imported rock materials that will be eventually used for the rock breakwater. In this scenario geotextile will be used to ensure separation between imported and indigenous materials so that total removal of the working platform can take place on completion.

Once the collapsing degraded pier head has been removed, concrete or steel piles will be driven into the ground using a piling rig (see Figure 3-6) positioned on the beach. The piles are required to support the weight of the structure for the new pier head. This will be carried out using a combination of pre-augering and driving of piles which will take place intermittently over two months. Precast concrete wall units will be manufactured in a factory and will be transported to South Pier. These will be built up in sections to form the shape of the pier. Once the external precast concrete shell is constructed, concrete pumps will be used to pump wet concrete into the pre-cast shell units to infill the units. Alternatively, to using precast sections, the contractor may decide to make up curved forms (moulds) which are put into the final wall positions into which concrete will be poured directly.

Along the south side of the pier, steel sheet piles over a 10m section will be placed along the base of the wall below the level of the shingle bank to protect the southern side of the pier from the effects of scour and abrasion which result from shingle moved around by strong waves.

Following the piling and installation of the external concrete walls and steel sheet piles, there will be a three-month period of wall grouting and stone masonry repairs. The horizontal and vertical grouting will require hand-held drills being used to drill into the wall face and top of the structure into any voids present. These holes will then be filled will temporary plastic pipes which will be used to pump lime and cement grout into the voids. Localised masonry repairs and repointing works will be required to the masonry face of the structure. These works will require the use of scaffolding (see Figure 3-7) and negative mobile elevated working platforms (see Figure 3-8) to undertake the repairs.

The relatively small amount of rock required at the end of the pier head will be constructed in a similar method to the breakwater and using the same source with the rock brought to site from either a Welsh or European quarry and transported to site by road or sea respectively. The rock colour will be specified to be grey, to remain consistent with the existing defence structures and the new breakwater construction at North Pier. Please refer to previous section for rock delivery, transport and placement methods.

3.2.2.3. South Beach - Groynes

The timber planks for the groynes will be removed using hand cutting tools and saws. The existing groyne piles will be removed by using an excavator with a grab or chain attachment. This plant will pull the piles out of the ground and place them into the wheeled dumpers for onward disposal. There are existing concrete steps present at the end of the existing timber groynes and these will need to be broken out with an excavator and a breaker. The material will then be placed into dumpers and disposed of at an off-site tip.

The groyne piles and timber planks will be brought onto the beach from the site compound on dump trucks. The timber posts will be inserted into the ground using a piling rig to drive the piles into the ground by a percussion and vibration piling technique. Hand tools will be used to attach the horizontal panels to the timber piles. The groyne works will take approximately two weeks to remove the existing groynes, two weeks to drive in the new piles and a further four weeks to attach the planks. Work will take have to take place at low tide to gain access and this has the benefit of avoiding sediment disturbance.

3.2.2.4. South Beach – Rock Revetment

To construct the new revetment, the existing rock revetment will be removed using an excavator (35t-40t) with a grab and rocks will be loaded onto dump trucks. The existing rocks will be stockpiled for re-use, with the existing 1-4t rocks to be re-used for the making up for low spots in the ground along the location of the proposed defence. Some of the existing shingle around the existing structure will be temporarily removed to construct the new revetment and will then be reinstated around the completed revetment on completion. The intention is to use all reclaimed rock and shingle within the South Beach works. Non-indigenous material

which may include hitherto undiscovered concrete, steel or other non-natural debris will be removed to an off-site tip.

An excavator on the beach will excavate the area where the new revetment will be placed. Approximately 8,848m^3 (5,550t) of shingle will be excavated, with all excavated material reused as nourishment. The excavated shingle material will be stockpiled within the beach above MHWS before it is needed for re-use, although this is not critical and shingle can be temporarily located immediately seaward of completed sections of revetment, before being relocated to its final position.

A geofabric separation membrane will then be laid onto the excavated surface prior to the placement of new rock for the revetment. The imported rock for the scheme will be transported to the site compound and stored there initially. The rock will then be transported to the beach by dumpers and tipped onto the beach. At this point the excavator with the grab will sort the rock into stockpiles for temporary storage on the beach before placing into the revetment. Rock will be placed to form the revetment using an excavator with a grab one rock at a time. This work will be undertaken at low tides. The volume of imported rock required for the revetment is estimated to be 14,534m^3.

3.2.2.5. South Beach - Renourishment

As described in the above sections, the material for the beach nourishment will be stockpiled on the beach following the breakwater and revetment excavation work, ready for re-use on the beach. It is unlikely that shingle material will also need to be imported, but if required, this would be brought from the site compound via dump trucks. A bulldozer (see Figure 3-5) will spread the material to the required slope at low tide.

3.2.2.6. Flood wall: Quay Parade

The removal of the existing flood wall and construction of the new raised wall will take place in sections to allow the existing flood wall to maintain its current function during the construction phase of the new works. This also allows parking to be maintained alongside the wall where work is not taking place and to maintain access along the road. Residents along Quay Parade have parking at the rear of their properties. It is estimated that approximately 5m length of wall will be removed per day and reconstruction of the same length of wall will take a further 4 days. Approximately 5m of wall will therefore be removed and reconstructed per week.

Work will commence with the removal of street furniture, lighting and signage. This will be carried out using hand tools, with the items set aside for re-instalment following construction. Currently, the lighting is located on the seaward side of the flood wall. Benches will be reinstated to their existing location on the seaward side of the wall with the potential for additional new seating to be provided. Options are also being considered to fix seating directly onto the walls.

The existing inland concrete flood wall will be removed in sections, including its foundation to a depth of 1.5m using an angle grinder, pneumatic breaker, excavator and dumper. Material will be removed from site by loading the material onto small 3 to 5T wheeled dump trucks.

Excavation will be carried out to a depth of 1m into the footway for the wall using disc cutters, pneumatic breakers and excavators to construct the footings for the new wall. The lower concrete and masonry-clad portion of the wall will be constructed by erecting steel reinforcement and pouring concrete into temporary timber formwork (moulds) to form the wall and foundations. The temporary formwork (moulds) is needed to keep the concrete in place while it is setting and is then removed once concrete is set. The concrete wall will be clad with stone masonry to provide a finish that is similar to the existing quay wall.

The glass panels will be manufactured in a factory and transported to Quay Parade. The glass panels will be inserted into pre-determined fixing points cast in the reinforced concrete wall, secured and sealed accordingly. The panels will be supported by steel posts on each side of the glass panel and fixed to the top of the wall.

The tilt barriers will be manufactured off site in a factory. Excavation through disc cutting and breaking will be carried out to a depth of 500mm into the footpath to recess the tilt barrier into the footway and to keep it flush (when closed) with the surrounding walkway. Each tilt barrier should take approximately 1 week to install.

3.2.2.7. Flood Wall: Pwll Cam to Monachty Hotel

The construction of this section of wall will follow a similar methodology to that at Quay Parade. Excavation will be carried out to a depth of 1m into the quayside for the wall footings using disc cutters, excavators and 3T dumpers. The lower masonry portion of the wall will be constructed by erecting temporary timber

formwork (moulds) to form the wall foundation and wall by pouring concrete between the formwork (moulds). Once concrete is set the temporary formwork will be removed leaving the shape of the new wall. The wall will be clad with the same stone masonry as the new wall at Quay Parade, to provide a finish that is similar to existing quay walls, and that will be in keeping with the existing surrounds. The glass panels will be transported to site from a factory, and will be fixed to the top of the wall by attaching them to steel columns fixed on top on the wall.

To the west of the entrance to Pwll Cam, and adjacent to The Hive, a short 10m long section of wall will also be raised with concrete and masonry cladding to 5.2mOD with glass panels.

A tilt barrier will be constructed at the entrance to the footbridge over the River Aeron. The tilt barriers will be manufactured off site for installation. A recess will be formed within the newly constructed terrace area to a depth of 500mm to house the tilt barrier into the footway. The tilt barriers are spring loaded and will be operated with a key held by CCC. The installation of the barrier should take approximately 1 week.

3.2.2.8. Flood Wall: Monachty Hotel to A487

To undertake the works from the footbridge to the property adjacent to the Monachty Hotel the existing rock revetment in front of the wall will need to be temporarily moved and placed alongside the river channel to create a working area/access track, so that the existing wall can be removed and the new wall constructed. It will also be necessary to remove part of the existing boundary wall at the rear corner of the Monachty Hotel to create an access route. The rock from the revetment will be shaped to retain a temporary working platform for the works in this area. This will be undertaken using excavators with a grab attachment working in the river when the tide is low. The excavators will be able to move into the harbour using the slipway at Doc Bach (near Beach Parade).

The new wall construction at Toad Hall will require the base to be constructed of a steel piled foundation driven into the hard ground using a piling rig (see Figure 3-6). Attached landward of the piles will be a (steel) reinforced concrete base for the wall. To construct this, there will be a need for a portable pump to pump out water at the bottom of the excavation (as a result of tidal ingress). On top of the concrete base a new vertical concrete wall will be constructed which will be clad with masonry. The top level of the wall will house glass panels to the same 5.2m AOD crest height as the other flood walls being constructed for this Scheme. On completion of these works the existing rock revetment will be relocated in its original position but placed against the new wall so that it matches its existing appearance and continues to provide scour protection along the river frontage.

The existing wall from the A487 road bridge will be connected to the new wall constructed between Pwll Cam and the Monachty Hotel as described above. Work to raise this stretch of existing wall will involve constructing a reinforced concrete capping beam onto the top of the wall which will be anchored into the existing wall using steel dowels and resin grouting. The small scale of work and limited access will necessitate using hand tools for the most part. The glass panels will be fixed to the top of the new capping beam between the new steel columns on top of the wall.

Construction access to carry out these works is very limited in this location due to the proximity of residential properties behind the wall. It is likely that a temporary scaffolding platform will be erected in the river channel next to the wall. Work to raise the wall would take place from this platform, thus avoiding the need to access the site from property gardens. Materials would be brought onto the working scaffold area via the temporary working area/access track to the rear of the Monachty Hotel. The scaffolding platforms would be screened to enable much of the debris from the works to land on the platform rather than falling into the water.

3.2.2.9. Pwll Cam Flood gate

A temporary sheet pile cofferdam will be constructed at the entrance of Pwll Cam to create a dry working area in the dock to install the flood gate. Pumps may be required to remove water and keep the area dry during working. Prior to constructing the cofferdam, a fish rescue will be undertaken. Once the cofferdam is in place a temporary working platform will be constructed from the Pwll Cam pier to the flood gate location, to enable access for machinery and workers. A geotextile layer will be placed on the seabed before the rocks are placed. The rocks and geotextile will be removed following construction.

To ensure that the walls supporting the gate have sufficient strength, a precast or formed concrete wall will be constructed to create the concrete abutments upon which the flood gate will be attached. Due to the access limitations at Pwll Cam, consideration of options for this aspect of the construction will be a key part of the contractor procurement process. If the wall is precast, the units would arrive to site from the factory by road. If a formed wall is proposed by the contractor, formwork (moulds) would be erected to form the

shape of the wall, with concrete then poured into the formwork before setting and then the formwork removed. The wall will be clad with stone masonry to provide a finish that is similar to the existing quay wall.

Drilling and grouting of walls will also take place to consolidate existing masonry and repair cracks and holes in the entrance channel walls alongside the Hive. The existing sill at the entrance to Pwll Cam will be removed by excavation using a saw cutter and excavator to remove existing concrete. A new concrete sill would then be cast onto the prepared ground.

For all of the wall grouting, drilling and lowering of the cill, this work would be done behind the cofferdam in the dry.

Piling (see Figure 3-6) will be required below the abutment walls and cill to provide the foundations for the wall abutments to resist the force of the water at high tide and during storm events. A total of 12 concrete or steel piles will be inserted into the harbour bed across the channel entrance underneath the footprint of the new gate. The piling will take place of a period of approximately 20 days. Piling is likely to be pre- augured and driven but will depend on the contractor's method statement and the results of the ground investigation. Two steel tension anchor bars for each abutment measuring 20mm in diameter, will also be drilled into the ground below the seabed to provide further resistance against the resultant forces of on the gate and abutments. Further anchor bars will be drilled into adjacent wall to provide additional structural restraint.

The flood gate will be manufactured off-site and is likely to be brought to site via a barge due to its size and the limited quayside access. A tug-boat will guide the barge (see Figure 3-11) into the harbour, with a crane positioned on the barge (see Figure 3-12) used to lift the gate into position. Depending on the time taken to offload the gate from the barge, the barge may need to rest on the harbour bed until it can leave on the next high tide. There will be a smaller crane located either in the car park (Figure 3-11) or adjacent to the slipway which will be used for ancillary activities.

There is a possibility that the gate might be installed from land and the gate brought in by road. An alternative option is that a temporary access road formed of crushed stone materials could be constructed from the slipway and along the eastern dock wall on the dock seabed to the gate location. This temporary structure would be installed after construction of the cofferdam and would provide a working platform to access the gate area including a location for a heavy-duty crane to position itself for lifting the gate.

Installation of the gate is the only aspect of the Scheme that may require some night-time working. This is because the installation is a continuous operation likely to take more than 12 hours to complete. The contractor would follow best practice procedures for work at night, including measures to minimise noise and directional lighting.

The construction of the gate will also require some digging of service trenches using saw cutters and excavators or similar to bury electrical cables for the gate operation which will connect to mains services in Market Street. A control kiosk to house the gate operating equipment will be constructed in close proximity to the gate. It is likely to be located to the east of the entrance to Pwll Cam adjacent to the gate. The design of this structure is not yet confirmed, but could be housed within a small compound comprised of masonry walls to blend with the existing abutment and flood defence walls.

Figure 3-1 Tracked Excavator with Bucket for Excavation

Figure 3-2 Tracked Excavator for Geotextile Placement

Figure 3-3 Tracked Excavator with Grab for Rock Placement

Figure 3-4 Wheeled Dumper Transporting Rock

Figure 3-5 Dozer to Spread out the Imported Shingle

Figure 3-6 Piling Rig

Figure 3-7 Scaffolding for South Pier and Wall Repairs

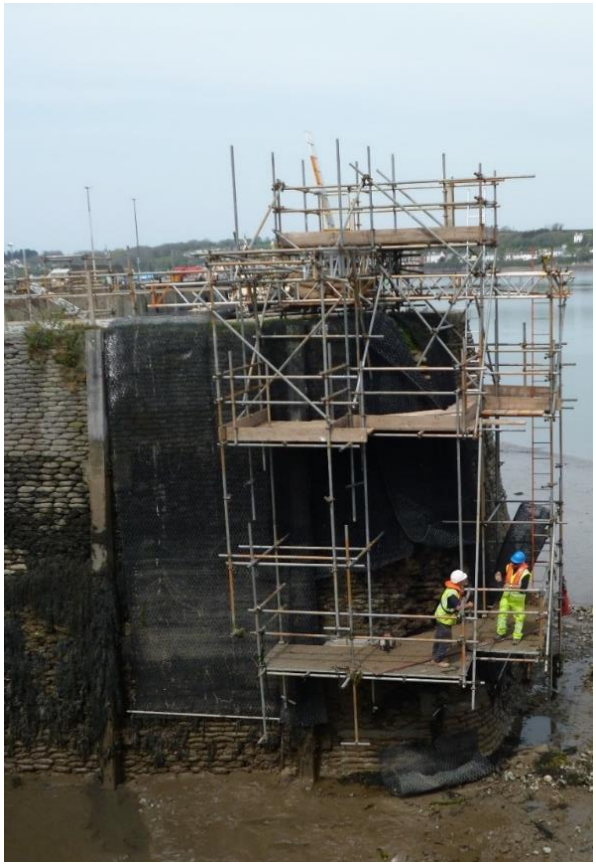

Figure 3-8 Negative Mobile Elevated Working Platforms (MEWP's)

Figure 3-9 Crane and Basket to Carry Operatives for Wall Repairs

Figure 3-10 Repointing and Wall Repairs by Rope Access

Figure 3-11 Barge, Tug, Crane and Gate

Figure 3-12 Barge, Crane and Gate

3.2.3. Outline Construction Programme

The works are scheduled to commence in winter 2021/2 and be completed by winter 2022/3, a duration of approximately 12 months. Construction will commence with the new breakwater with the other Scheme elements overlapping over the 12 month period. It is estimated that the construction timescale for each phase of the works will be as follows:

Activity	Programme
New breakwater	12 months
Restoration of South Pier	6 months
Flood Walls	6 months
Pwll Cam flood gate	9 months
South Beach improvement works	9 months

It should be noted that these durations are weather dependent and will rely on the contractor appointed and their detailed method statement.

In order for the Scheme to be completed in the shortest time possible, construction will be carried out Monday to Sunday from 7am to 7pm. Within these working hours, significant elements of work will be restricted to periods of low tide only. Work that can take place at all tide states will include work to all three flood walls and the grouting repairs of quay walls. There will be no work over Christmas, New Year and Easter public holiday and Bank Holidays.

3.3. Operation

Following construction, the Scheme will provide protection from erosion and flooding for a 1 in 200 year standard of protection from flooding through wave overtopping of the harbour walls. The Scheme has been designed to account for current predictions of sea level rise over the next 100 years. Numerical modelling of the breakwater has indicated that sediment accretion may occur at the seaward end of the breakwater and in the harbour channel. Further assessment of this can be referred to in Table 6-3.

Following construction, CCC will carry out regular maintenance of all elements of the scheme. CCC will also undertake monitoring of seabed levels following construction, to ensure that navigation into the harbour is maintained and that important habitats are not significantly adversely impacted. Maintenance dredging or removal of sediment would be carried out in consultation with NRW if accretion continued at a pace considered to be detrimental to marine habitats and navigational access. CCC already undertakes maintenance dredging of the harbour.

3.4. Decommissioning

No decommissioning is required or proposed as part of the Scheme and therefore decommissioning effects have not been considered within the assessment.

4. Screening

4.1. Screening of WFD Water Bodies

A screening exercise was completed to identify waterbodies that are relevant to the Aberaeron Coastal Defence Scheme. A study boundary also known as zone of influence was set for the screening, which was the immediate footprint of the works, plus (for surface waters) one water body upstream and downstream of the site. For groundwater, only immediately underlying groundwater bodies were included in the screening, as individual groundwater bodies are designated as “hydraulically coherent” systems that do not have interactions with other groundwater bodies.

Aberaeron is within the Western Wales River Basin District (RBD) and the management strategies for the District are stated in the Western Wales River Basin Management Plan (RBMP). The first RBMP was published in 2009 and set out the management plan for the first cycle of six years 2009-2015. The plan was updated in 2015 to cover the second cycle 2015-2021 and will be updated again in 2021 (yet to be published), and so on. The purpose of the RBMP is to protect and improve the water environment for the wider benefits to people and wildlife – to achieve ‘Good’ status. The majority of baseline data within the study area was obtained from Natural Resources Wales (NRW) Water Watch Wales at https://waterwatchwales.naturalresourceswales.gov.uk. This includes the:

- Draft RBMP Consultation Data Oct 2021
- 2018 Cycle 2 Interim Classification
- Wales Water Body Objectives and Measures Update 2017

4.1.1. Surface Water Bodies

In the Western Wales River Basin District, the following surface water bodies are classified as within the zone of influence:

- Cardigan Bay Central (ID: GB651009030000)
- Aeron – confluence with Gwili to tidal limit (ID: GB110063041450)

Cardigan Bay Central is a designated coastal water body covering an area of 104 km^2 and which extends upstream to the tidal limit on the River Aeron. The works will take place within this waterbody. Cardigan Bay (the area encompassing all three designated beaches) is a popular tourist destination partly due to its Blue Flag beaches and the potential for spotting a local population of Bottlenose dolphins, which are a designated feature of the Cardigan Bay Special Area of Conservation (SAC) (Visit Wales, 2021a).

Aberaeron’s coastline is split into two main beaches - North and South beach. Neither of the beaches are designated bathing waters. The closest designated bathing waters are Llanrhystud and three areas at New Quay with the closest approximately 7km away; all were classified as ‘Excellent’ or ‘Sufficient’ in 2017 (Welsh Government, 2021).

Upstream of Aberaeron harbour is the River Aeron (Afon Aeron) which flows through the town of Aberaeron and discharges into the sea at the harbour mouth. The River Aeron waterbody extends upstream from the tidal limit. Although this waterbody is not within the immediate area of the works, it is in close proximity. The overall WFD classification for the River Aeron waterbody is ‘Moderate’, with diffuse pollution from farming noted to be the reason why the waterbody has not achieved ‘Good’ status to date. The Aeron catchment is predominately rural in nature and supports an important sea trout fishery with a limited number of salmon also present (NRW, 2018). There are local targeted measures to control diffuse pollution led by NRW. It is also noted that there is a National Measure to be led by the Welsh Government to review the legislation surrounding rural diffuse pollution to also tackle this cause of poor water quality throughout Wales.

Local targeted measures for the River Aeron waterbody have been defined as:

- To control or manage diffuse source inputs;
- Reduce diffuse pollution at source; and
- Farm Infrastructure.

A summary of the screened surface water bodies WFD classification is provided in Table 4-1 below using data provided at https://waterwatchwales.naturalresourceswales.gov.uk. The location of the Scheme in relation to screened surface water bodies is shown in Figure 4-1.

Table 4-1 Summary of WFD Classification for Surface Water Bodies

Name	Type	Hydromorphological designation	Waterbody ID	Area (km^2)	Protected Area Designation	Overall Status Cycle 1	Overall Status Cycle 2[2]	Overall Status Objective[3]
Cardigan Bay Central	Coastal	High	GB651009030000	104km^2	Bathing Water Directive Special Area of Conservation (SAC)	Good	Good	Good by 2027
Aeron – confluence with Gwili to tidal limit	River	High/Supports Good	GB110063041450	12.15km (Length)	Not Designated	Moderate	Moderate	Good by 2027

4.1.2. Groundwater Bodies

The groundwater body underlying Aberaeron is the Teifi and Coastal Ceredigion groundwater body. Under the Western Wales RBD, this groundwater body forms part of a Drinking Water Protected Area (DWPA). Teifi and Coastal Ceredigion groundwater body has been assessed as 'not at risk'. The RBMP determined some of the following sources that can impact on groundwater bodies not being able to achieve 'Good' status such as:

- Unregulated discharges e.g. from abandoned mines, leaking subsurface sewers; and
- Pollution from rural areas e.g. excessive use of nutrients such as nitrates.

A summary of the screened ground water bodies WFD classification is provided in Table 4-2 below using data provided at https://waterwatchwales.naturalresourceswales.gov.uk. The location of the Scheme in relation to the extent of the groundwater body is shown in Figure 4-1.

Table 4-2 Summary of WFD classifications for Groundwater Waterbodies

Name	Type	Waterbody ID	Grid Reference	Protected Area Designation	Overall Status Cycle 1	Overall Status Cycle 2[2]	Overall Objective[3]
Teifi and Coastal Ceredigion	Ground water	GB41002G203300	N/A	Drinking Water Protected Area	Poor	Poor	Poor* by 2027

Note: * considered 'technically infeasible' to achieve good water quality by 2021 due to the presence of minewater (NRW River Basin Management Planning Overview Annex) and due to 'disproportionate cost' in the Draft RBMP Consultation data Oct 2021 at https://waterwatchwales.naturalresourceswales.gov.uk.

[2] 2018 C2 Interim Classification.xlsx (accessed https://waterwatchwales.naturalresourceswales.gov.uk)
[3] Draft RBMP Consultation Data Oct 2021.xlsx (accessed https://waterwatchwales.naturalresourceswales.gov.uk)

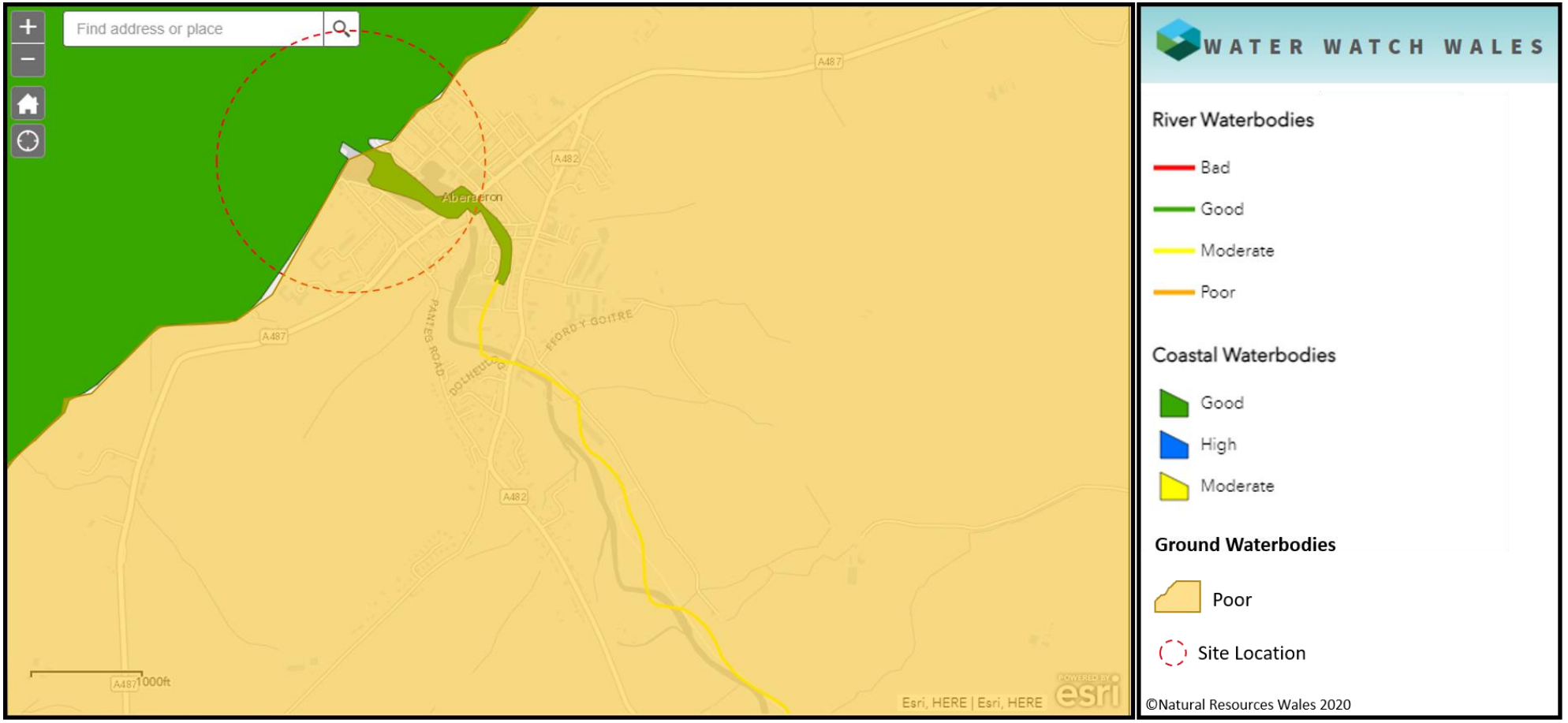

Figure 4-1 Waterbodies Relevant to the Scheme

4.1.3. Screening Summary

The following WFD water bodies were screened in for further assessment:

- Cardigan Bay Central (ID:GB651009030000)
- Aeron – confluence with Gwili to tidal limit (ID: GB110063041450)
- Teifi and Coastal Ceredigion (GB41002G203300)

4.2. Screening of Relevant Scheme Activities

For the three waterbodies screened in for further assessment, activities that could impact on the status of the waterbodies were identified for construction and operational stages. The activities that should be screened in for further assessment are detailed in Table 4-3 to Table 4-5.

Table 4-3 Screening of Scheme Activities: Construction Stage

Scheme element	Activity	Screening rationale
Site establishment and demobilisation	Creation and demobilisation of temporary compound	Screen out – The development of a temporary compound will be located on a field behind South Beach and away from the surface water bodies. There will be no direct pathways for any of the site compound activities to affect the surface water bodies. No deterioration or impacts to designated ground water bodies are expected from the site compound. Best practice guidelines will be followed by the Contractor for the storage and use of all fuels and chemicals, including the use of welfare facilities.
North Pier breakwater	Excavation, rock placement, movement of plant and machinery along the beach, vessel movement.	Screen in – Activities associated with the breakwater construction, pier refurbishment, groyne replacement, revetment refurbishment and beach recharge e.g. excavation, movement of machinery along South Beach, potential for vessels delivery rock. All of these activities have the potential to impact on surface water and ground water quality elements.
Re-building seaward head of South Pier	Excavation, re-building of pier head, piling, movement of plant and machinery along the beach.	Screen in – Removal of existing pier material and reconstruction of the pier head has the potential to impact on surface water quality elements and ground water quality elements. This part of the work will involve piling.
Improvements to South Beach	Groyne replacement, rock revetment, excavation, shingle recharge and operation of plant and machinery on the beach	Screen in – Groyne replacement, rock revetment and shingle replenishment have the potential to impact on surface water quality elements and ground water quality elements.
Harbour wall raising	Drilling, concrete repairs, temporary scaffold in the River Aeron, piling for the new wall length at the Monachty Hotel	Screen in – These works have the potential to impact on surface water quality elements. No deterioration or impacts to ground water bodies are expected as all ground-break works will be superficial.

Pwll Cam flood gate	Temporary cofferdam, temporary rock platform for construction access from the slipway to the gate and piling.	Screen in – The installation of Pwll Cam flood gate has the has the potential to impact on surface water quality elements, including fish entrapment, and ground water quality elements.

Table 4-4 Screening of Scheme Activities: Operation Stage

Scheme element	Activity	Screening rationale
North Pier breakwater	Presence of new structure along the coastline.	Screen in – The installation of a rock breakwater may change the hydromorphological regime/ coastal processes of this area and therefore has the potential to impact surface water quality elements. No deterioration or impacts to ground water bodies are expected as no ground-breaking works will be taking place post-construction.
Harbour wall raising and Pwll Cam flood gate	New flood gate at Pwll Cam which will be closed during storm events. Increased flood wall height along the edge of the harbour and River Aeron.	Screen in – Potential for changes in hydromorphological processes as a result of closure of flood gate during storm events. Screen in – Risk of fish entrapment from the operation and closure of the Pwll Cam flood gate during storm events. Screen in – Potential for changes in hydromorphological processes as a result of increased flood wall height in the harbour.

Table 4-5 Screening of Scheme Activities: Decommissioning Stage

Scheme element	Activity	Screening rationale
None	None	Screen out - The Scheme does not include any decommissioning activity and has a design life of 100 years.

5. Scoping

5.1. Waterbody Baseline Data

The waterbody data in tables 5.1 to 5.3 below has been taken from both the Wales Waterbody Objectives and Measures 2017 data and the 2018 C2 Interim Classification data at https://waterwatchwales.naturalresourceswales.gov.uk. Where information was not available in the 2018 data, the 2017 data has been used. Neither of these data sources contain information on specific pollutants for any of the waterbodies screened into the assessment.

5.1.1. Cardigan Bay Central

Table 5-1 WFD Status – Cardigan Bay Central

Waterbody: – Cardigan Bay Central **Overall status: Good** **Ecological status: Good** **Chemical status: Good** **Mitigation measures: Not Yet Assessed**		
Biological quality elements:	Physico-chemical quality elements:	Hydromorphological supporting elements:
Fish: Not Assessed	Temperature: Not Assessed	Hydrological Regime: Not Yet Assessed
Invertebrates: Good	pH: Not Assessed	Morphology: High
Macroalgae: High	Dissolved oxygen: High	HMWB: No
Phytoplankton: High	Dissolved Inorganic Nitrogen: High	
	All metal assessed: High	

Cardigan Bay Central is a designated coastal water body covering an area of 104 km^2 (See Section 4.1.1). A summary of the baseline classification for Cardigan Bay Central water body is provided in Table 4-1 with more detail on the WFD status provided in Table 5-1. Based on the 2018 interim Cycle 2 data, Cardigan Bay's overall WFD classification is 'Good' with ecological and chemical status also classified as 'Good'. Invertebrates have been assessed as the element driving the ecological status.

5.1.2. River Aeron

Table 5-2 WFD Status – River Aeron with Gwili to Tidal Limit

Waterbody: – River Aeron with Gwili to tidal limit **Overall status: Moderate** **Ecological status: Moderate** **Chemical status: Good** **Mitigation measures: Not Yet Assessed**		
Biological quality elements:	Physico-chemical quality elements:	Hydromorphological supporting elements:
Fish: Good	Temperature: High	Hydrological Regime: High
Invertebrates: High	pH: High	Morphology: Supports Good
Macrophytes: Moderate	Dissolved oxygen: High	HMWB: No
Phytobenthos: Moderate	Phosphate: High	
	All metals: Not assessed	

The River Aeron is a designated river water body with a length of 12.5 km (See Section 4.1.1). A summary of the baseline classification for the River Aeron water body is provided in Table 4-1, with more detail provided in Table 5-2. Based on Cycle 2 data, River Aeron's overall WFD classification is 'Moderate', with ecological

and chemical classified as 'Moderate' and 'Good' respectively. Macrophytes and Phytobenthos have been assessed as the element driving the ecological status.

5.1.3. Teifi and Coastal Ceredigion

Table 5-3 WFD Status – Teifi and Coastal Ceredigion

Waterbody: – Teifi and Coastal Ceredigion (Groundwater) **Overall status: Poor** **Quantitative status: Good** **Chemical status: Poor**

The Teifi and Coastal Ceredigion groundwater bodies overall status was classified as 'Poor' in 2018 with objectives to achieve 'Poor' overall status by 2027. The groundwater chemical status was assessed as 'Poor' whilst Quantitative status and Drinking Water protected status was assessed as 'Good'. No reason for the water body not achieving good status has been determined. However, Cycle 2 data determined a WFD failing element as 'Chemical Dependent Surface Water Body Status'. The RBMP determined specific sources that may impact on groundwaters reaching 'Good' status as discussed in Section 4.1.2.

Preliminary ground investigation (GI) works have taken place within the Scheme area as detailed below. During GI works undertaken in 2008 (Quantum Geotechnical, 2008), groundwater was encountered at depths between 2.07m – 7.09m (dependant on the tide). In 2013 groundwater testing of the harbour was undertaken (Hyder Consulting, 2013). This testing demonstrated that any rise in tide level results in a rise in groundwater level, as the fill material behind the quay is highly permeable (porous). Therefore, it was determined that groundwater could be impacted from activities taking place in the intertidal area. The extent of GI works that have been undertaken include:

- Quantum in 2008 (Quantum Geotechnical, 2008) - the extent of which covered the boundaries of the inner and outer harbours including the North and South Piers.
- WYG in 2019 (WYG, 2019) - the extent of which covered the northern edge of the harbour, South Pier and the entire length of the southern beach.
- Quantum in 2021 (Quantum Geotechnical, 2021) - the extent of which included the harbour area.

These reports have been supplied with the Marine Licence application made for this Scheme and are available on request.

5.1.4. Protected Areas and Sensitive Habitats

The WFD Protected Areas and WFD sensitive habitats within a 2km proximity to the site (as per the EA recommendation (EA, 2016)) are summarised in Table 5-4. The majority of the information provided on Sensitive Habitats has been sourced from Natural England's interactive MAGIC online mapping service. The location of these habitats is shown in Figure 5-1.

Table 5-4 Summary of WFD Protected Areas and Sensitive Habitats

WFD Protected Areas	Location in relation to the Scheme
Special Area of Conservation (SAC)	West Wales Marine/ Gorllewin Cymru Forol SAC and Cardigan Bay/ Bae Ceredigion SAC.
Special Protection Area (SPA)	The closest SPA - Northern Cardigan Bay / Gogledd Bae Ceredigion is over 18km north of the site.
Drinking Water Protected Area	The closest Drinking Water Protected Area is over 17km east of the site.
Bathing Waters	One bathing water approximately 10km north of the site and three designated bathing waters south of the site near New Quay. The closest of the three-bathing waters is approximately 7km from the site.
Shellfish Water Protected Area	The closest Shellfish water protected area is located over 30 km north of the site.

WFD Protected Areas	Location in relation to the Scheme
Nitrate Vulnerable Zones	The closest Nitrate Vulnerable Zone is located over 30 km North of the site.
WFD Sensitive Habitats	**Location in relation to the Scheme**
Mussel Beds (Higher Sensitivity)	Sections of mussel beds are shown along North Beach.
Polychaete Reef (Higher Sensitivity)	Significant sections of polychaete reef are spread along North Beach. A site walkover survey determined no Polychaete reef along South Beach.
Gravel and Cobbles (Lower Sensitivity)	Most of the intertidal area of North Beach consists of Gravel and Cobbles with a smaller section located north of South Beach.
Subtidal Rocky Reef (Lower Sensitivity)	The majority of subtidal seabed up to 3.5 km from Aberaeron Harbour consists of Subtidal Rocky Reef.
Intertidal Soft Sediments – sand, mud and mixed (Lower Sensitivity)	There is a small section of Intertidal Soft Sediment located on South Beach.
Rocky Shore – intertidal rock (Lower Sensitivity)	There is a large section of Rocky Shore located north of North Beach, a significant section covering South Beach and some sections located within and near the harbour mouth along the edge of the River Aeron opposite Pwll Cam.

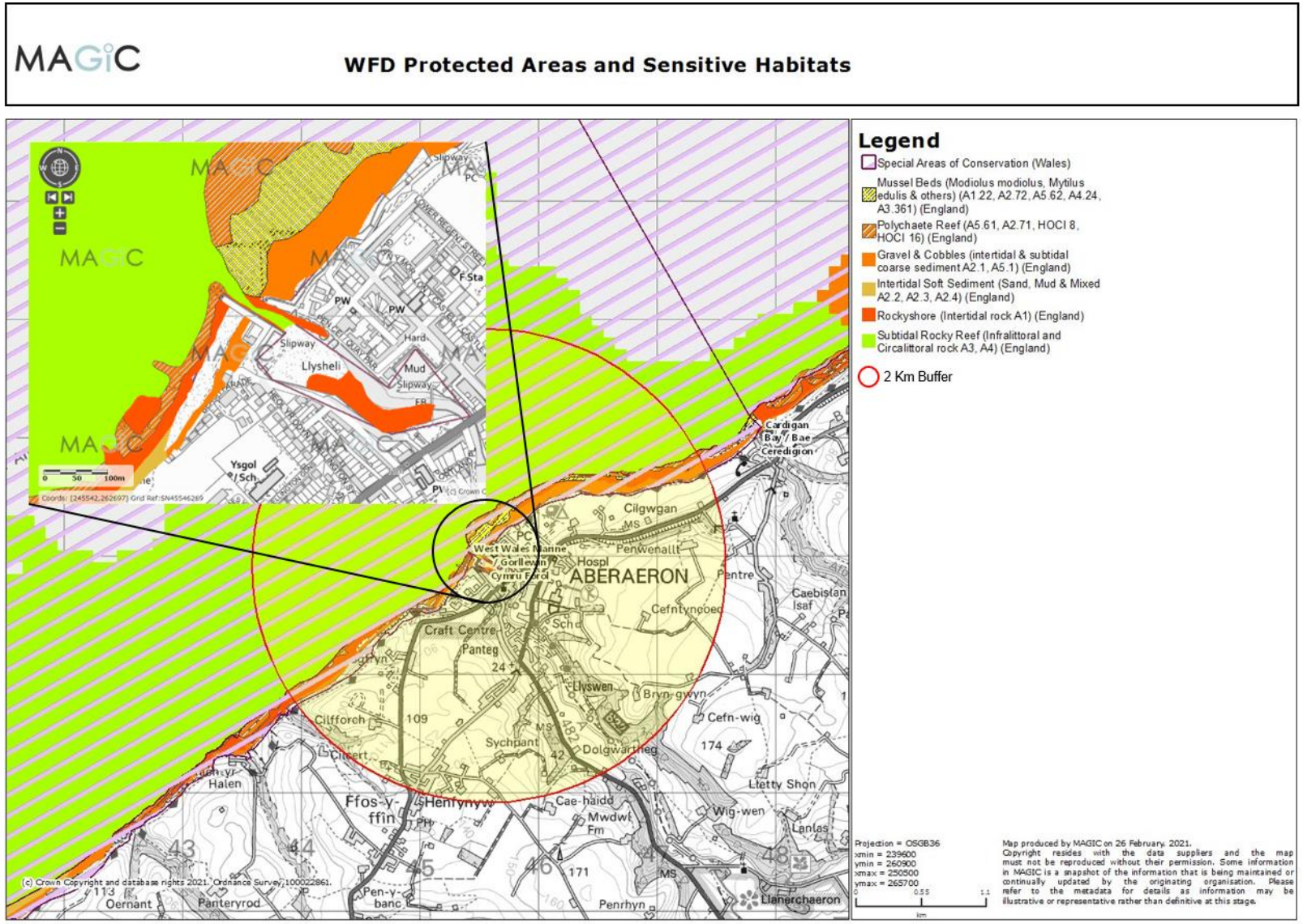

Figure 5-1 Protected Areas and Sensitive Habitats

5.1.5. Fish

NRW regularly carries out fish surveys to monitor the biology and status of fish stocks within key watercourses. Two monitoring sites have been located on NRW Water Watch Wales interactive mapping along the River Aeron. However, no data is available. Fish have not yet been assessed under the WFD classification for Cardigan Bay Central water body. Fish have been assessed as 'Good' for the River Aeron water body (See Section 5.1). This does not conclude the absence of fish from Cardigan Bay.

When designating Cardigan Bay SAC, River Lampreys were recorded in Aberaeron Harbour and migrating up the River Aeron. However, numbers were not sufficient to record the population's conservation status as favourable. No Sea Lamprey were recorded in the area during this survey Countryside Council for Wales, 2009). Both species are designated features of the Cardigan Bay SAC.

5.2. Scoping of Scheme Activities

A Scoping exercise has been undertaken to identify the potential risks of each Scheme activity that was screened in for further assessment. The Scoping process has followed the Clearing the Waters for All guidance, and has considered the risks of the Scheme activities during the construction and operation stages (as screened in in Section 4.2) to the following receptors for surface water bodies:

- Hydromorphology;
- Biology – habitats;
- Biology – fish;
- Water quality (physico-chemical); and
- Protected Areas.

The Scoping exercise is documented in Appendix A. Tables 5-5 to Table 5-6 present the summary results of the identified risks and receptors that have been taken forward to the assessment stage for the Cardigan Bay Central and River Aeron surface water bodies.

The Clearing the Waters for All scoping guidance is not applicable for groundwater bodies as certain receptors such as hydromorphology and biology are not relevant. The Teifi and Coastal Ceredigion ground water body has been taken forward to the assessment stage due to the potential interaction with groundwater from excavation and piling activities and chemical leaks and spills.

Table 5-5 Summary of Scoping for Cardigan Bay Central Water Body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	Construction – Temporary cofferdam in Pwll Cam. Operation stage – New breakwater has the potential to impact on coastal processes. The operation of the flood gate could impact on the hydromorphological regime in the harbour. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events.
Biology: habitats	Yes	Construction - Loss of sensitive habitat such as mussel beds and polychaete reef (*Sabellaria alveolata*). Operational – Changes to coastal processes from the new breakwater could impact on adjacent sensitive habitats – mussel beds and *S.alveolata*.
Biology: fish	Yes	Construction – Potential impacts from noise/vibration particularly during piling operations. Potential disturbance to migration up/downstream. Risk of entrapment from erection of temporary cofferdam during the Pwll Cam works.

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
		Operation – Risk of entrapment in Pwll Cam when the flood gate is closed during storm events.
Water quality (physico-chemical)	Yes	Construction - Potential disturbance and re-mobilisation of contaminated sediments during excavation. Risk of chemical spills and leaks into the water. Risk of increased turbidity from sediment disturbance during excavation. Operation - Changes in hydromorphological conditions caused by the breakwater could affect salinity, temperature and oxygen levels.
Protected areas	Yes	Construction and Operation stages – The Scheme is located in both the Cardigan Bay SAC and West Wales Marine SAC. All other protected areas have been scoped out. The Scheme will create a permanent loss in area of both of the SACs.
Invasive non-native species	No	Scoped out as no INNS of concern identified and the Contractor will be instructed to implement bio-security measures to reduce the spread of INNS. A bio-security risk assessment will also be produced as good practice.

Table 5-6 - Summary of Scoping for River Aeron Water Body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	Construction – Temporary cofferdam in Pwll Cam. Operation stage – The operation of the flood gate could impact on the hydromorphological regime in the harbour. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events.
Biology: habitats	No	Scoped out. There will be no work within the River Aeron waterbody as it lies upstream of the works. All of the work within the harbour and along the tidal part of the river by the A487 bridge, that could potentially affect the waterbody upstream, will take place from the land, with the exception of a short length of piling by the footbridge and a scaffold in the channel for access to the river wall. The scaffold will be screened to prevent debris from falling into the river and the piling will take place within the bank and not within the water.
Biology: fish	Yes	Construction – potential impacts from noise/vibration particularly during piling operations. Potential disturbance to migration up/downstream. Risk of entrapment from erection of temporary cofferdam during the Pwll Cam works. Operation – Risk of entrapment in Pwll Cam when the flood gate is closed during storm events.
Water quality (Physico-chemical)	Yes	Construction - Potential disturbance and re-mobilisation of contaminated sediments during excavation. Risk of chemical spills and leaks into the water. Risk of increased turbidity from sediment disturbance during excavation.
Protected areas	No	There are no Protected Areas within the River Aeron waterbody.
Invasive non-native species	No	Scoped out as no INNS of concern identified and the Contractor will be instructed to implement bio-security measures to reduce the spread of INNS. A bio-security risk assessment will be produced as good practice.

6. WFD Assessment

6.1. Ground Investigation

The ground investigation, completed by Quantum Geotechnical in January 2021 at locations within the harbour and foreshore (see Figure 6-1), included collection of soil samples for laboratory analysis. A summary of the analysis undertaken is provided below.

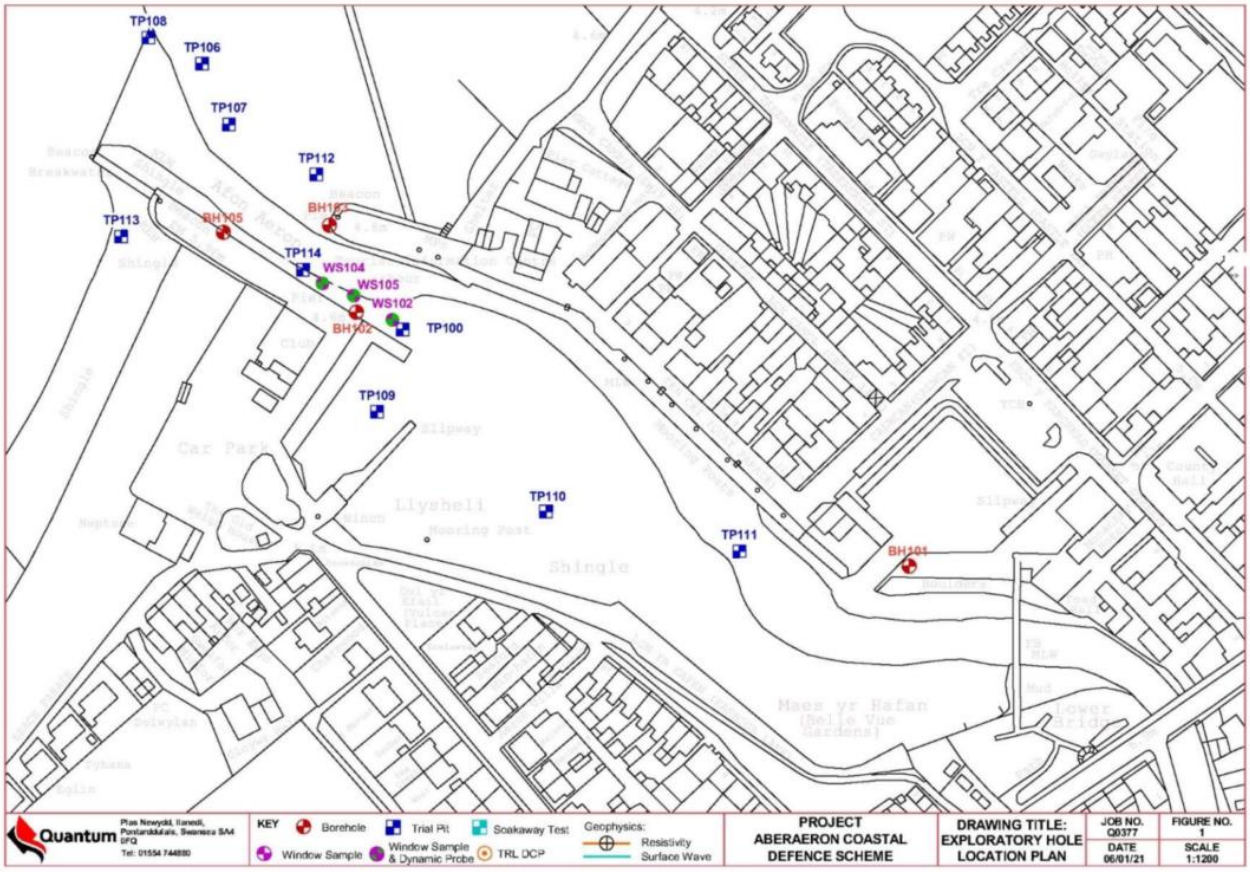

Figure 6-1 Location of 2021 Geotechnical Investigation

6.1.1. Soil Sampling

A total of eight soil samples were selected for chemical analysis. The samples were taken from three locations TP109, TP110 and TP111 at depths between 0.1 and 2m. The locations were selected based on knowledge of present day and historical land uses that could have generated contaminated material. The chemical analysis considered the following:

- pH;
- asbestos screen (with quantification if asbestos identified);
- Fraction of Organic Carbon (FOC) and organic matter;
- inorganic parameters: cyanide (total, free and complex), sulphate, sulphide, sulphur, ammonium, ammonia, ammoniacal nitrogen;
- metals / metalloids: antimony, arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, copper,
- lead, manganese, mercury, nickel, selenium, vanadium and zinc;
- total phenols;
- benzene, toluene, ethylbenzene and xylene (BTEX);

- speciated polycyclic aromatic hydrocarbons (PAHs) USEPA16; and,
- total petroleum hydrocarbons criteria working group (TPH CWG), C5 – C44.

6.1.2. Cefas Action Levels

The results of the soil sampling (as detailed above) have been compared with Cefas Action Levels[4] in Table 6-1 below. The results are shown in Appendix B.

Cefas Action Levels determine the suitability of dredge materials for disposal at sea, with below Action Level 1 – being of no concern and are unlikely to influence the licencing decision, Action Levels 1 and 2 require further consideration and above Action level 2 is generally considered unsuitable for sea disposal.

Table 6-1 Comparison of Soil Samples with CEFAS Action Levels

Determinand	Unit	CEFAS Thresholds		Aberaeron Soil Sample Results		Comparison to CEFAS Action Level
		Action level 1	Action level 2	Minimum Value	Maximum Value	
Arsenic	mg/kg	20	100	12	19	<1
Cadmium	mg/kg	0.4	5	<0.1	0.1	<1
Chromium	mg/kg	40	400	18	30	<1
Copper	mg/kg	40	400	19	68	<1
Lead	mg/kg	50	500	12	79	1
Mercury	mg/kg	0.3	3	<0.1	<0.1	<1
Nickel	mg/kg	20	200	31	44	1
Zinc	mg/kg	130	800	81	130	1

The results show that:

- Slight exceedances of Action Level 1 were found for lead, nickel and zinc but these were well below action level 2.
- Only one location (TP110) exceeded Action Level 1 for lead.
- All locations were slightly in exceedance of Action Level 1 for nickel, averaging around 36 mg/kg.
- Only one location (TP110) was at the threshold of the Action Level 1 with all other locations below Action Level 1.

Locations TP109, TP110 and TP111 are in locations where present day and historical land uses could cause a risk of contamination. However, no excavation and/or dredging of these locations is planned. Where removal of materials is planned is outside of areas with present or historical land contamination risk, it is anticipated that all these locations will be below Cefas Action Level 1.

6.1.3. Soil Leachate

A selection of four soil samples were selected for 10:1 ratio soil leachate analysis to BSEN1245-2 (2002) for the following testing suite:

- pH;
- inorganic parameters: cyanide (total and free), sulphate, sulphide, ammonium, chloride;

[4] Marine Licensing: sediment analysis and sample plans https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans###Suitability%20of%20material [accessed November 2021]

- metals / metalloids: calcium, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, manganese, magnesium, mercury, molybdenum, nickel, potassium, selenium, sodium, tin, vanadium and zinc; and,
- total phenols.

6.1.4. Controlled Waters

To assess potential risks to the identified controlled water receptors, groundwater laboratory data has been screened against water quality standards (WQS). The screening criteria selected for controlled waters assessment are dependent on the nature of the receptor.

Drinking Water Standards have not been adopted as WQS due to the location of the site in the inter-tidal zone and potential saline nature of the groundwater which would make it unlikely that it would be utilised as a future potable resource.

Therefore, the primary receptor is the surface water of the River Aeron. Soil leachate data have been screened against coastal and estuarine Environmental Quality Standards (EQS) to assess the potential risk posed to the surface water receptor.

6.1.5. Soil Leachate Assessment Results

Four soil-leachate samples were subject to leachate analysis to BS EN 12457-2 at a dilution ratio of 10:1. The screening results indicate that concentrations of arsenic, copper, lead and iron exceeded the WQS as summarised in Table 6-2.

The soil leachate screening assessment is provided in Appendix B.

Table 6-2 Summary of WQS Soil Leachate Exceedances (EQS)

Determinand	No. of samples	WQS (EQS) (mg/l)	Max. Concentration (mg/l)	No. of Exceedances	Location of Exceedances
Arsenic	4	0.025	0.054	1	TP109, 0.1m
Copper	4	0.00376	0.0067	1	TP111, 1m
Lead	4	0.0013	0.0094	1	TP111, 1m
Iron	4	1.0	1.2	1	TP111, 1m

6.1.6. Discussion of Potential Risks to Controlled Waters

The results indicate that there are exceedances of heavy metal against the WQS for arsenic, copper, lead and iron.

The risks of contaminated soils to the controlled water receptors are not considered to be unacceptable when noting the following lines of evidence:

- the copper and lead EQS screening criteria are conservative Tier 1 values which have not been adjusted for metal bioavailability (m-BAT) based on the chemistry of the receiving water;
- the recorded concentration for copper and lead are less than an order of magnitude above the WQS and spatially, the elevated concentrations are isolated to two locations, TP109 and TP111 within the inner harbour area;
- laboratory soil-leachate tests are generally aggressive and overestimate leachable concentrations which would be observed under natural environment site conditions; and
- samples recovered comprised a recorded high percentage of gravel which may have been crushed for sampling, potentially affecting the elemental composition of the analysed sub-sample, increasing the surface area of the material and therefore available leachable surfaces.

6.2. WFD Assessment of Impacts

Tables 6-3 to 6-5 present the results of the WFD assessment for Cardigan Bay, River Aeron and Teifi and Coastal Ceredigion water bodies. This assessment considers the effects of the Scheme during both the

construction and operational phases on the WFD quality elements of the water body. Where necessary, mitigation measures are proposed to address potential effects.

Table 6-3 Assessment of Impacts on the Cardigan Bay Central Water Body

Hydromorphology	Biology	Physico-chemical	Protected Areas	Control Measures that will be employed throughout the works
Hydrological regime: Quantity and dynamics of water flow, tidal prism. **Morphological conditions:** water column depth variation; Structure and substrate of the sea bed. **Mitigation Measures:** Conflict with or contribution to Mitigation Measures for HMWBs	**Sensitive Habitats:** Extent and quality of habitats **Fish fauna:** Species composition and abundance; Presence of type-specific disturbance sensitive species; Age structure of fish communities. **Other elements**: Invertebrates and macroalgae.	**Parameters:** Salinity, Nutrient concentrations, pH, Oxygen balance; Acid neutralising capacity, Temperature, Transparency. **Pollution** by all priority substances identified as being discharged into the water body. **Pollution** by other substances identified as being discharged in significant quantities into the water body.	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives and the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas.	
Assessment of Impact	**Assessment of Impact**	**Assessment of Impact**	**Assessment of Impact**	
The proposed Scheme has the potential to impact on the hydromorphology quality element of Cardigan Bay Central waterbody both during and following construction. **Construction** A temporary cofferdam will be constructed across the mouth of Pwll Cam to create a dry working area for the installation of the flood gate. This will reduce the area available for water ingress, particularly during high tides. Modelling of fluvial flows with the Pwll Cam entrance closed shows no impact on fluvial flows in the 1 in 1000 extreme scenario and therefore no risk to changes in hydromorphology during construction of the flood gate. **Operation** Following construction the new breakwater will impact on coastal processes, in relation to interrupting the predominant sediment transport to the north-east, with accretion predicted to occur at the end of the breakwater and in the harbour mouth. The Cardigan Bay Central waterbody is currently at high hydromorphological status and Aberaeron is the only section of coastline within this waterbody that is already significantly artificially modified. The following assessment considers the significance of the change in coastal processes alongside the risk raised during the consultation process that the scheme could reduce the high status of the waterbody. An assessment of the scheme on the coastal processes has been undertaken for the EIA of the scheme and is contained in the Environmental Statement (Atkins, 2021). A Sediment	The Scheme has the potential to impact on the biological quality element of the Cardigan Bay Central waterbody to both habitats and fish during construction and operation. **Construction (Habitats)** The construction of the breakwater will result in the permanent loss of seabed habitat. Mussel beds and polychaete reef (*Sabellaria* sp.) are both present along the coastline of Aberaeron. A subtidal survey was undertaken in September 2019 of the seabed in the area of the proposed breakwater. Within the immediate footprint of the breakwater the main biotopes identified were moderate energy littoral rock and *Fucus vesiculosus* (Bladder wrack seaweed) on mid eulittoral rock. *Sabellaria alveolata* (polychaete) reefs were identified to the east and north-east of the breakwater. Although not identified in the survey, mussel beds are present along North Beach. Based on the subtidal survey, there will be limited interaction with these higher sensitive habitats. Any loss of habitat will be localised and minimal in comparison to the abundance of polychaete reef and mussel bed in the surrounding intertidal area, which will be negligibly affected by the construction works. **Operation (Habitats)** Numerical sediment modelling was undertaken to assess the effect on *Sabellaria* reef and other protected habitats in this water body particularly due to the risk of potential smothering or scouring (Atkins, 2020). Modelling results determined that the presence of the breakwater would alter sea-bed levels local to the structure compared to the baseline conditions. This was most notable to the south west of North beach where an increase in sediment load was reported in the location of *Sabellaria* reef. These changes may directly impact on non-mobile species such as mussel beds and *Sabellaria* reef	The proposed Scheme has the potential to impact on physico-chemical quality elements during construction and operation. **Construction** Construction impacts could occur from disturbance and re-mobilisation of potentially contaminated sediments and contamination from chemical leaks and/or spills into the water and release of debris from repair work to the piers and harbour walls. <u>Mobilisation of Contaminated Sediments</u> Excavation for the breakwater could cause re-mobilisation of contaminated sediments into the water is particularly linked with the excavation of the new breakwater foundations which are taking place below MLW. Ground investigation works were undertaken in the surrounding harbour areas and beaches. This included: • Quantum in 2008 (Quantum Geotechnical, 2008) in 2008 - the extent of which covered the boundaries of the inner and outer harbours including the North and South Piers. • WYG in 2019 (WYG, 2019) - the extent of which covered the northern edge of the harbour, South Pier and the entire length of the southern beach. • Quantum in 2021 (Quantum Geotechnical, 2021) - the extent of which included the harbour. Sampling did not include the piers or beach as these locations are not considered to be potential sources of contamination as they have no record of previous historical uses which indicate locations at risk of contamination. No visual or olfactory evidence of contamination was discovered during the Quantum 2008 and WYG 2019, further adding to the unlikely risk that contamination could be present beach locations.	The following protected areas have been considered as part of this assessment: • Bathing Waters • Special Areas of Conservation All other protected areas, as classified above, are located over 10km from the Scheme and therefore highly unlikely to be impacted by the Scheme and are excluded from this assessment. The nearest Bathing Water is at near New Quay, approximately 7km south of Aberaeron. The Scheme is located within the West Wales Marine SAC and the Cardigan Bay SAC. **Construction** <u>Bathing Waters</u> The Scheme will not result in any new direct discharges during construction that could affect bacterial loading; all temporary welfare units will be self-contained and located away from the waterbodies in a grassed field behind South Beach. <u>Special Areas of Conservation</u> During construction the Scheme will result in the permanent loss of a small area of both SACs: • 0.0074% of the Cardigan Bay SAC • 0.00009% of the West Wales Marine SAC A Habitats Regulations Assessment (HRA) has been undertaken of the effects of the Scheme on these protected areas. The HRA has concluded that the Scheme will have no adverse impact on the integrity of either SAC. **Operation**	• Most works will be carried out at low tide and during daylight hours. This will avoid any noise transmission within the water column, and avoid the need for artificial lighting that could disturb migratory fish. • The Scheme will utilise a circular waste system within the site. • Site compounds, materials and equipment will be appropriately secured and fenced off, away from the site if necessary. • The Scheme will make use of well-maintained equipment and plant to minimise potential for fuel/oil and chemical leaks. Plant and machinery will be switched off when not in use. • All equipment and materials used will be in a clean condition prior to their arrival on site, and on removal from site. • The proposed works will follow the Guidance on Pollution Prevention (GPPs)[5] in particular GPP5 Work in or Near Water, and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites.

[5] Documents are available at http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/. GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.

Hydromorphology	Biology	Physico-chemical	Protected Areas	Control Measures that will be employed throughout the works
Hydrological regime: Quantity and dynamics of water flow, tidal prism. **Morphological conditions:** water column depth variation; Structure and substrate of the sea bed. **Mitigation Measures:** Conflict with or contribution to Mitigation Measures for HMWBs	**Sensitive Habitats:** Extent and quality of habitats **Fish fauna:** Species composition and abundance; Presence of type-specific disturbance sensitive species; Age structure of fish communities. **Other elements**: Invertebrates and macroalgae.	**Parameters:** Salinity, Nutrient concentrations, pH, Oxygen balance; Acid neutralising capacity, Temperature, Transparency. **Pollution** by all priority substances identified as being discharged into the water body. **Pollution** by other substances identified as being discharged in significant quantities into the water body.	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives and the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas.	
Modelling Report (Atkins, 2021) has also been produced detailing the modelling results. The modelling shows that the breakwater will cause some interruption to the predominant north-west longshore sediment transport. This is already seen from the presence of South Pier, in the lee of which sediment has accreted, with this part of the beach being wider than that in the south. Over the years, North Beach has been affected by low sediment input as a result of the piers. Although sediment interruption is already occurring as a result of South Pier, the extension of the breakwater further seaward will cause more sediment to be prevented from north-east transport. Numerical modelling has been undertaken to assess the change in sediment processes from the present day scenario to a scenario with the breakwater. The modelling shows that accretion is already occurring offshore of South Beach, in the harbour mouth and along North Beach, with bed level changes over one year estimated to be up to +1.2m in places. The accretion along North Beach is the result of coast protection measures already in place to trap any incoming sediment. With the breakwater in place, the modelling shows a similar pattern of accretion in terms of location, but with a higher rate of accretion, up to above 1.6m over the course of one year. It is important to note, however, that the model did not include fluvial flows from the River Aeron, which will play a significant role in dispersing sediment in the mouth of the harbour. The model was also not calibrated against real-time data and therefore these values should be used to infer a trend towards accretion, rather than actual quantities. Monitoring of sea bed levels will be undertaken following construction.	in the long term. However, due to the localised nature and scale of these impacts this is not expected to significantly deteriorate the overall sensitive habitats in this water body. The changes may also indirectly impact benthic invertebrates locally around the site in the short term from the morphological changes. However, again these are expected to be localised and minimal in comparison to the abundance of these habitats within the surrounding area. Moreover, the increased wave protection from the breakwater may also positively increase species composition and abundance for species such as lobsters and crabs. The subtidal area near Aberaeron is known for local fisherman using crab and lobster pots. Significant consideration on the size of the footprint of the new breakwater has been undertaken to ensure a suitable level of flood protection whilst limiting the potential impacts on the biological quality elements of the waterbody. Any potential local impacts to biological quality elements will be minimised through control measures employed throughout the works. Therefore, due to the localised and small-scale nature of these impacts in relation to the sensitive habitats in this waterbody. The Scheme will not result in the any deterioration to the biological quality elements of this water body during construction or operation. **Construction (Fish)** During construction there is the potential for impacts on fish from noise/vibration. The majority of the works along the coastline will take place at low tide, to avoid working in the water. However, part of the breakwater construction will be carried out underwater below MLWS. Noisy activities include excavation for the breakwater foundations and placement of the geotextile layer and rock, work to the South Pier which includes piling, as well as piling for the timber groynes. The delivery of rock and tipping of the rock from the barge onto the beach would also generate noise. Piling operations will be undertaken at low tide and outside of the water to reduce the generation of percussive noise in the water and a soft start approach will be used. Within the harbour and river, piling will take place for the Pwll Cam flood gate and for the stretch of wall upstream of the	Where sampling did take place in the harbour where there is present and past historical use, the materials were generally below Cefas Action Level 1 but with slight exceedances – however this material is not being removed. Soil analysis for soil leachates were tested as part of these GI works and results determined that no visual or olfactory evidence of contamination was evident and when assessed against WQS the risk were considered acceptable. Therefore, it is extremely unlikely that any additional contaminants will be mobilised during construction that are not already within the normal background levels of the area. Piling is not anticipated to create any arisings. The Contractor will be expected to have a Site Waste Management Plan and a Materials Management Plan in place prior to construction. <u>Turbidity</u> Sediment mobilisation has the potential to (Atkins, 2020)[08] has demonstrated that changes to flow velocities and sediment transport will be minimal, and highly localised to the site. Furthermore, as part of the GI works ((WYG, 2019) and (Quantum Geotechnical, 2021) lab testing for Particle Size Distribution (PSD) was undertaken. This was mainly to determine that the material excavated as part of the foundations for the breakwater, would be suitable for the South Beach nourishment. PSD Analysis confirmed that the majority of material in this area was within the Sand/Gravel/Cobble range. Therefore, it is likely this will further limit the turbidity when excavation is taking place due to the material type not mainly consisting of fine sediments. Effects on temperature or oxygen balance are highly unlikely as there will be no changes in water levels, flow velocities or nutrient concentrations as a result of the Scheme. Furthermore, no new discharges will be introduced to the water body as a result of the Scheme. Additionally, any disturbance during construction will be short term, temporary and restricted to the immediate area. <u>Release of Debris</u>	<u>Bathing Waters</u> The Scheme will not result in any new direct discharges during operation that could affect bacterial loading. <u>Special Areas of Conservation</u> The new breakwater will impact on coastal processes which could have an impact on the features of the designated sites, in particular the *S.alveolata* reef. The impact on the coastal processes and the reef is discussed in the 'hydromorphology' and 'biology' columns in this table. Both assessments, including the HRA, has concluded that the Scheme will have no adverse impact on the integrity of the SACs.	

Hydromorphology	Biology	Physico-chemical	Protected Areas	Control Measures that will be employed throughout the works
Hydrological regime: Quantity and dynamics of water flow, tidal prism. **Morphological conditions:** water column depth variation; Structure and substrate of the sea bed. **Mitigation Measures:** Conflict with or contribution to Mitigation Measures for HMWBs	**Sensitive Habitats:** Extent and quality of habitats **Fish fauna:** Species composition and abundance; Presence of type-specific disturbance sensitive species; Age structure of fish communities. **Other elements**: Invertebrates and macroalgae.	**Parameters:** Salinity, Nutrient concentrations, pH, Oxygen balance; Acid neutralising capacity, Temperature, Transparency. **Pollution** by all priority substances identified as being discharged into the water body. **Pollution** by other substances identified as being discharged in significant quantities into the water body.	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives and the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas.	
Maintenance dredging will be carried out if required. Due to the localised nature of the impact in relation to the overall waterbody size, the breakwater will not result in the deterioration of the hydromorphological quality elements of this waterbody and will not change the current high status of the waterbody. <u>Highly Modified Designation</u> Consultation with NRW has raised the concern that the Scheme could change the waterbody to becoming designated a A/HMWB waterbody. The piers at the harbour mouth have been in place for 200 years, and the groyne field along South Beach and North Beach are thought to have been in place for almost 50 years. The Aberaeron coast has therefore been artifically modified for a significant period of time. During this period, the groynes have been replaced, including the North Beach works in 2009; replacement timber groynes, new section of rock revetment, rock groynes, reconstruction of the sea wall and a beach nourishment programme. Although the breakwater will create some localised change in coastal processes as discussed above, this will be confined to the area around Aberaeron and will not change the waterbody to an A/HMWB. <u>Flood Gate</u> During storm events the flood gate will be closed to prevent flooding via the flood path through Pwll Cam. Modelling of fluvial flows with the Pwll Cam gate closed shows no detrimental effect on fluvial flows in the 1 in 1000 extreme scenario. <u>Harbour Wall Raising</u> During operation the Scheme has the potential to impact on the upstream fluvial hydrology, from the enhanced flood defences along the River Aeron.	footbridge. The piling for the flood gate will take place within the cofferdam, therefore in the dry with a lower risk of noise being generated into the water. Similarly, the piling for the wall will take place within the river bank and not in the water. Given the limited work taking place under water and the mitigation measures, impacts are not considered to be significant. There is also a risk of entrapment during construction from the temporary cofferdam used to hold back the water in the harbour to create a dry working area in Pwll Cam. A fish rescue will be carried out before water is pumped out of the cofferdam area so that no fish are left stranded in Pwll Cam. Aberaeron is recognised as an important area for migrating fish. Consultation has taken place with NRW and 'in water' working upstream from the South Pier will not take place between April and October to reduce the risk of impacts. **Operation (Fish)** Following construction, the closure of the flood gate during storms could result in fish entrapment, which could be a cause for concern should the gate be closed for a number of days. However, water levels will be maintained by a penstock to maintain around 1.5m of water depth.	The work to the harbour walls, piers and flood gate, could result in materials falling into the water. Much of the harbour wall work will be undertaken from land, except for the work along the river by the Monachty Hotel and the A487. Here a scaffold will be used in the river. The scaffold will be fully sheeted to prevent debris falling into the river. The flood gate work will be done within the cofferdam where it is 'dry' and all materials removed before the cofferdam is taken away. Materials for repairs will such as grout mortar which is being used during the harbour wall raising to reinforce the harbour walls, will contain additives to significantly reduce any mixing with the water. <u>Leaks/Spills</u> The risk of pollution events and spillages from machinery and equipment will be mitigated through best practice working measures, including the adherence to the Guidelines on Pollution Prevention (GPPs) and management through the Construction Environmental Management Plan (CEMP). **Operation** During operation, the installation of the breakwater has the potential to impact the salinity and clarity of the water body due to changes in turbidity levels from sediment movement. However, as discussed above, these impacts are expected to be minimal due to the numerical sediment modelling (Atkins, 2020) and GI works that have taken place. Finally, due to the dynamic environment of this water body the Scheme is unlikely to significantly impact the physico-chemical quality elements of this waterbody any impacts are considered to be negligible.		

Hydromorphology	Biology	Physico-chemical	Protected Areas	Control Measures that will be employed throughout the works
Hydrological regime: Quantity and dynamics of water flow, tidal prism. **Morphological conditions:** water column depth variation; Structure and substrate of the sea bed. **Mitigation Measures:** Conflict with or contribution to Mitigation Measures for HMWBs	**Sensitive Habitats:** Extent and quality of habitats **Fish fauna:** Species composition and abundance; Presence of type-specific disturbance sensitive species; Age structure of fish communities. **Other elements**: Invertebrates and macroalgae.	**Parameters:** Salinity, Nutrient concentrations, pH, Oxygen balance; Acid neutralising capacity, Temperature, Transparency. **Pollution** by all priority substances identified as being discharged into the water body. **Pollution** by other substances identified as being discharged in significant quantities into the water body.	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives and the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas.	
Modelling shows no negative impact on flood levels as a result of the raised defences during a 1 in 1000/0.1% annual probability flood event.				
The proposed Scheme will not result in any deterioration to hydromorphological supporting elements provided that monitoring of seabed levels is carried out following construction of the breakwater and maintenance dredging carried out where necessary. **The proposal is deemed to be COMPLIANT with this WFD quality element.**	**The proposed Scheme will not result in any significant deterioration to biological supporting elements with the mitigation measures discussed in place.** **The proposal is deemed to be COMPLIANT with this WFD quality element**	**The proposed Scheme will not result in any deterioration to physico-chemical supporting elements.** **The proposal is deemed to be COMPLIANT with this WFD quality element**	**The proposed Scheme will not result in any deterioration to protected areas that could affect the integrity of them.** **The proposal is deemed to be COMPLIANT with this WFD quality element**	

Table 6-4 Assessment of Impacts on the River Aeron Water Body

Hydromorphology	Biology	Physico-chemical	Protected Areas	Control Measures that will be employed throughout the works
Hydrological regime: Quantity and dynamics of water flow, tidal prism. **Morphological conditions:** water column depth variation; Structure and substrate of the sea bed. **Mitigation Measures:** Conflict with or contribution to Mitigation Measures for HMWBs	**Sensitive Habitats:** Extent and quality of habitats **Fish fauna:** Species composition and abundance; Presence of type-specific disturbance sensitive species; Age structure of fish communities. **Other elements**: Invertebrates and macroalgae	**Parameters:** Salinity, Nutrient concentrations, pH, Oxygen balance; Acid neutralising capacity, Temperature, Transparency. **Pollution** by all priority substances identified as being discharged into the water body. **Pollution** by other substances identified as being discharged in significant quantities into the water body.	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives and the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas	
Assessment of Impact	**Assessment of Impact**	**Assessment of Impact**	**Assessment of Impact**	
Construction A temporary cofferdam will be constructed across the mouth of Pwll Cam to create a dry working area for the installation of the flood gate. This will reduce the area available for water ingress, particularly during high tides. Modelling of fluvial flows with the Pwll Cam entrance closed shows no impact on fluvial flows in the 1 in 1000 extreme scenario and therefore no risk to changes in hydromorphology during construction of the flood gate. **Operation** Flood Gate During storm events the flood gate will be closed to prevent flooding via the flood path through Pwll Cam. Modelling of fluvial flows with the Pwll Cam gate closed shows no detrimental effect on fluvial flows in the 1 in 1000 extreme scenario. Harbour Wall Raising During operation the Scheme has the potential to impact on the upstream fluvial hydrology, from the enhanced flood defences along the River Aeron. Modelling shows no negative impact on flood levels as a result of the raised defences during a 1 in 1000/0.1% annual probability flood event.	**Construction (Habitats)** Scoped out. **Operation (Habitats)** Scoped out. **Construction (Fish)** Please refer to the assessment in Table 6-3 above for the Cardigan Bay Central waterbody. **Operation (Fish)** Please refer to the assessment in Table 6-3 above for the Cardigan Bay Central waterbody.	**Construction** Please refer to the assessment in Table 6-3 above for the Cardigan Bay Central waterbody. **Operation** Scoped out.	There are no Protected Areas within the River Aeron waterbody that are within the vicinity of the works. **Construction** Scoped out. **Operation** Scoped out.	• Most works will be carried out at low tide and during daylight hours. This will avoid any noise transmission within the water column, and avoid the need for artificial lighting that could disturb migratory fish. • The Scheme will utilise a circular waste system within the site. • Site compounds, materials and equipment will be appropriately secured and fenced off, away from the site if necessary. • The Scheme will make use of well-maintained equipment and plant to minimise potential for fuel/oil and chemical leaks. Plant and machinery will be switched off when not in use. • All equipment and materials used will be in a clean condition prior to their arrival on site, and on removal from site. • The proposed works will follow the Guidance on Pollution Prevention (GPPs)[6] in particular GPP5 Work in or Near Water, and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites.
The proposed Scheme will not result in any deterioration to hydromorphological supporting elements. The proposal is deemed to be COMPLIANT with this WFD quality element	**The proposed Scheme will not result in any deterioration to biological supporting elements. The proposal is deemed to be COMPLIANT with this WFD quality element**	**The proposed Scheme will not result in any deterioration to physico-chemical supporting elements. The proposal is deemed to be COMPLIANT with this WFD quality element**	**The proposed Scheme will not result in any deterioration to protected areas. The proposal is deemed to be COMPLIANT with this WFD quality element**	

[6] Documents are available at http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/. GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.

Table 6-5 Assessment of Impacts on the Teifi and Coastal Ceredigion Groundwater Body

Quantitative • Quantitative dependant surface waters • Quantitative groundwater dependent ecosystems • Quantitative saline intrusion • Water balance	**Chemical** • Chemical dependant surface waters • Drinking water protected areas • Chemical groundwater dependant ecosystems • Chemical saline intrusion	**Protected Areas** Areas with water-dependent habitats that are protected under the Birds and Habitats Directives, and (by Government policy) under the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas	**Control Measures that will be employed throughout the works**
Assessment of Impact	**Assessment of Impact**	**Assessment of Impact**	
The Scheme will involve ground-breaking works such as piling and excavation. The piling will take place for the South Pier works, Pwll Cam flood gate and for the section of new wall by the Monachty Hotel. There is a risk that these activities could connect to the underlying groundwater. Saline intrusion into the groundwater is not expected as the piling at South Pier will take place at low water; in the dry behind the cofferdam at Pwll Cam; and in the river bank (not in the water) along the River Aeron. Should any small scale intrusion occur, the scale of the ground-breaking works would not be significant enough to alter the quantitative elements of the groundwater body as a whole. Any local changes would regulate quickly (as groundwater levels in the area are dynamic and fluctuate with the tide regardless) with no residual adverse effects anticipated. No impacts to quantitative quality impacts are expected during the operation of the Scheme.	The Teifi and Coastal Ceredigion groundwater is currently at 'Poor' status, due to the 'poor' status in the general chemical test. This indicates groundwater in the area is adversely affected by high levels of contaminants in the soil, mostly likely caused by historic mining activity and rural and agricultural land management in the wider area. Excavation during construction could disturb any contaminated sediments. Ground investigation works were undertaken in the surrounding harbour areas and beaches. This included: • Quantum in 2008 (Quantum Geotechnical, 2008) in 2008 - the extent of which covered the boundaries of the inner and outer harbours including the North and South Piers. • WYG in 2019 (WYG, 2019) - the extent of which covered the northern edge of the harbour, South Pier and the entire length of the southern beach. • Quantum in 2021 (Quantum Geotechnical, 2021) - the extent of which included the harbour. Sampling did not include the piers or beach as these locations are not considered to be potential sources of contamination as they have no record of previous historical uses which indicate locations at risk of contamination. No visual or olfactory evidence of contamination was discovered during the Quantum 2008 and WYG 2019, further adding to the unlikely risk that contamination could be present beach locations. Where sampling did take place in the harbour where there is present and past historical use, the materials were generally below Cefas Action Level 1 but with slight exceedances – however this material is not being removed. Soil analysis for soil leachates were tested as part of these GI works and results determined that no visual or olfactory evidence of contamination was evident and when assessed against WQS the risk were considered acceptable. Therefore, it is extremely unlikely that any additional contaminants will be mobilised during construction that are not already within the normal background levels of the area.	There are no Drinking Water Protected Areas (DWPA), Shellfish Waters and Bathing Waters within 2km from the Scheme. Refer to **Table 6-3** for assessment on SACs.	• The Scheme will utilise a circular waste system within the site. • Site compounds, materials and equipment will be appropriately secured and fenced off, away from the Site if necessary. • The Scheme will make use of well-maintained equipment and plant to minimise potential for fuel/oil and chemical leaks. Plant and machinery will be switched off when not in use. • All equipment and materials used will be in a clean condition prior to their arrival on site, and on removal from site. • The proposed works will follow the Guidance on Pollution Prevention (GPPs)[7] in particular GPP5 Work in or Near Water, and the Construction Industry Research and Information Association (CIRIA) guidance on the control of water pollution from construction sites.

[7] Available at http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/. GPPs provide environmental good practice guidance for the whole UK, and environmental regulatory guidance directly to Northern Ireland, Scotland and Wales only.

Quantitative	Chemical	Protected Areas	Control Measures that will be employed throughout the works
• Quantitative dependant surface waters • Quantitative groundwater dependent ecosystems • Quantitative saline intrusion • Water balance	• Chemical dependant surface waters • Drinking water protected areas • Chemical groundwater dependant ecosystems • Chemical saline intrusion	Areas with water-dependent habitats that are protected under the Birds and Habitats Directives, and (by Government policy) under the Ramsar Convention, Drinking Water Protected Areas, Shellfish Waters, Bathing Waters and Nutrient Sensitive Areas	
	The Contractor will be expected to have a Site Waste Management Plan and a Materials Management Plan in place prior to construction. Spills and leaks from construction machinery could also impact on groundwater. The risk will be mitigated through best practice working measures, including the adherence to the Guidelines on Pollution Prevention (GPPs) and management through the Construction Environmental Management Plan (CEMP). No impacts to chemical quality impacts are expected during the operation of the Scheme.		
The proposed Scheme will not result in any deterioration to quantitative elements. The proposal is deemed to be COMPLIANT with this WFD quality element.	**The proposed Scheme will not result in any deterioration to chemical quality elements. The proposal is deemed to be COMPLIANT with this WFD quality element.**	**The proposed Scheme will not result in any deterioration to Protected Areas. The proposal is deemed to be COMPLIANT with this WFD quality element.**	

7. Conclusion

This report details the WFD assessment carried out for the proposed coastal defence scheme at Aberaeron. It has assessed the Scheme against the biological, physico-chemical and hydromorphological quality elements of Cardigan Bay Central and the River Aeron surface waterbodies, and the quantitative and chemical quality elements of the Teifi and Coastal Ceredigion ground waterbody.

The Scheme will not result in deterioration to any of the elements for the three waterbodies assessed, providing the mitigation measures that have been recommended are implemented.

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Appendix A. Scoping of Scheme Activities

SCHEME INFORMATION

Your activity	Description, notes or more information
Name of activity	Aberaeron Coastal Defence Scheme
Brief description of activity	Enhanced coast defence to provide increased protection to the town of Aberaeron from coastal flooding will comprise of 5 linked elements: -Construction of a new breakwater extending from North Pier - Enhancements to South Beach by groyne replacement and shingle replenishment - Refurbishment to South Pier - Harbour wall raising - Installation of flood gate at Pwll Cam
Location of activity (central point XY coordinates or national grid reference)	Central National Grid Reference SN 45455 62789
Footprint of activity (ha)	4.37 ha approximately
Timings of activity (including start and finish dates)	Winter 2021 – Winter 2022 (estimated)
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	The activity covers the footprint area of the following elements of the Scheme (approximately 4.37 ha). Individual footprint areas for the linked elements mentioned below: - North Pier breakwater: 1.08 ha - South Beach and South Pier enhancement: 3.27 ha - Flood gate installation: 0.02 ha

	This is an overestimate to include the whole area of where the works are likely to take place in these areas e.g. activities taking place on South beach will not cover the entire beach area, but the whole area has been included in the estimate. The harbour wall raising has not been included as these activities are taking place landward and will not impact upon any waterbodies. There will be no outputs or regular discharges in either construction or operation.
Use or release of chemicals (state which ones)	No chemicals will be used in construction or released from the site in operation.

SCOPING: CARDIGAN BAY CENTRAL

Water body	Description, notes or more information
WFD water body name	Cardigan Bay Central
Water body ID	GB651009030000
River basin district name	Western Wales
Water body type (estuarine or coastal)	Coastal
Water body total area (ha)	10400
Overall water body status (2018)	Good
Ecological status	Good
Chemical status	Good
Target water body status and deadline	Good by 2027
Hydromorphology status of water body	High
Heavily modified water body and for what use	N/A
Higher sensitivity habitats present	Yes
Lower sensitivity habitats present	Yes
Phytoplankton status	High
History of harmful algae	Not assessed
WFD protected areas within 2km	Yes

Specific risk information

The potential risks of the Scheme on each of the following receptors has been considered: hydromorphology, biology (habitats and fish), water quality, protected areas and invasive non-native species (INNS).

Section 1: Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status	Requires impact assessment	~~Impact assessment not required~~	Yes - This is a high status water body. The introduction of the breakwater could affect hydromorphology and maintaining the 'high' waterbody status as well as the operation of the Pwll Cam flood gate during storms. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events.
Could significantly impact the hydromorphology of any water body	Requires impact assessment	~~Impact assessment not required~~	Yes - The introduction of the breakwater could affect hydromorphology during operation of the Scheme as well as the operation of the Pwll Cam flood gate during storms. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events. During construction the temporary cofferdam at Pwll Cam could also impact on river flows.
Is in a water body that is heavily modified for the same use as your activity	Requires impact assessment	~~Impact assessment not required~~	No - This waterbody is not designated A/HMWB. However the introduction of the breakwater could impact on this designation and should be further assessed.

Section 2: Biology

Habitats

Habitats of sensitivity that have been considered include the following.

Higher sensitivity habitats	Lower sensitivity habitats
chalk reef	cobbles, gravel and shingle
clam, cockle and oyster beds	intertidal soft sediments like sand and mud
intertidal seagrass	rocky shore
maerl	subtidal boulder fields
mussel beds, including blue and horse mussel	subtidal rocky reef
polychaete reef	subtidal soft sediments like sand and mud
saltmarsh	
subtidal kelp beds	
subtidal seagrass	

Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5km^2 or larger	Yes, to one or more – requires impact assessment	~~No to all – impact assessment not required~~	No – Footprint of activity is approximately 0.04km^2.
1% or more of the water body's area			No – Footprint of activity is 0.04% of the water body's area.
Within 500m of any higher sensitivity habitat			Yes – Potential risks associated during both construction and operation stages. Mussel beds and polychaete reefs are located immediately adjacent to the North Pier and along North Beach. They are at risk from the construction of the breakwater. During operation there could be risks (e.g. smothering) associated with potential changes in coastal processes.

1% or more of any lower sensitivity habitat			No – Rocky shore is present in the mouth of the harbour and rocky reef extending out from the mouth of the harbour (See Figure 5-1). The footprint of any activities likely to impact on lower sensitivity habitat is less than 1%.

Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	Continue with questions	~~Go to next section~~	Yes – the works will take place within the lower tidal River Aeron, Aberaeron Harbour (including the harbour mouth) and beyond the harbour entrance along South Beach.
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	~~Impact assessment not required~~	Yes – the work will involve noisy activities including piling; and will take place in an area important for fish migration. There is a risk of fish entrapment both during construction and operation (see row below).
Could cause entrainment or impingement of fish	Requires impact assessment	~~Impact assessment not required~~	Yes – there is the potential for fish entrapment during the cofferdam work at Pwll Cam. Following construction, the closure of the flood gate during storms could also risk fish entrapment.

Section 3: Water quality

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	~~Impact assessment not required~~	Yes - Construction activities particularly those that require excavation have the potential to re-mobilise contaminated sediments. There is also a risk of turbidity and debris falling into the water, as well as chemical leaks and spills. Operation - Changes in morphological conditions due to the installation of the breakwater may impact on sediment movement patterns which in turn may affect salinity, temperature and oxygen levels.
Is in a water body with a phytoplankton status of moderate, poor or bad	~~Requires impact assessment~~	Impact assessment not required	No - Phytoplankton assessed as High.
Is in a water body with a history of harmful algae	~~Requires impact assessment~~	Impact assessment not required	Not assessed for this water body.

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	~~Impact assessment not required~~	Intrusive ground investigations were undertaken by (WYG, 2019) and (Quantum Geotechnical, 2021). Both investigations determined that no visual or olfactory evidence of contamination was evident within the site investigation locations. Chemical analysis has been

			undertaken of 8 soil samples and the results should be assessed.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	~~Impact assessment not required~~	Intrusive ground investigations were undertaken by (WYG, 2019) and (Quantum Geotechnical, 2021). Chemical analysis has been undertaken of 8 soil samples and the results should be assessed against Cefas Action Levels.

If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	~~Requires impact assessment~~[5]	Impact assessment not required	No chemicals are to be released during construction or operation.

Section 4: WFD protected areas

Protected area types considered include the presence of the following.

• special areas of conservation (SAC)	• bathing waters
• special protection areas (SPA)	• nutrient sensitive areas
• shellfish waters	

Consider if your activity is:	**Yes**	**No**	**Protected areas risk issue(s)**

Within 2km of any WFD protected area	Requires impact assessment	~~Impact assessment not required~~	Yes - the Scheme is located in the Cardigan Bay SAC and West Wales Marine SAC. Drinking Water Protected Area (DWPA), Shellfish Waters and Bathing Waters are all present but >2km from the proposed activity. Risk of impacts is considered negligible.

Section 5: Invasive non-native species (INNS)

Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	~~Requires impact assessment~~	Impact assessment not required	No – INNS have not been recorded on the site to date. However, *Sargassum muticum* (Brown seaweed) has been recorded in the Cardigan Bay SAC. According to NBN datasets (NBN Atlas Wales, 2021), there are records of this species including south of South Beach. It is noted that these seem outside of the construction limits of the Scheme. However, construction activities will be managed through on-site 'toolbox' talks and bio-security measures to avoid the introduction of INNS from plant and machinery used in other locations or coming from overseas. No impacts are expected as part of the Schemes operation.

Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	Construction – Temporary cofferdam could affect river flows and hydromorphology. Operation – Installation of the rock breakwater which has the potential to change hydromorphology. Closure of the flood gate at Pwll Cam could also affect river flows and processes. The raising of the flood walls could also affect hydromorphology in terms of water levels and flows during storm events.
Biology: habitats	Yes	Construction stage - Loss of sensitive habitat such as mussel beds and polychaete reef. Operational stage – Changes to morphological conditions has the potential to cause impact on sensitive habitats.
Biology: fish	Yes	Construction – potential impacts from noise/vibration particularly during piling operations. Potential disturbance to migration up/downstream. Risk of entrapment from erection of temporary cofferdam during the Pwll Cam works. Operation – Risk of entrapment in Pwll Cam when the flood gate is closed during storm events.
Water quality	Yes	Construction - Potential disturbance and re-mobilisation of contaminated sediments during construction activities; increased turbidity;risk of debris falling in the water; spills and leaks from machinery. Operation - Changes in morphological conditions due to the installation of the breakwater may impact on sediment movement which in turn may affect salinity, temperature and oxygen levels.
Protected areas	Yes	Construction and Operation stages – The Scheme is located within the Cardigan Bay SAC and West Wales Marine SAC. All other protected areas have been scoped out.
Invasive non-native species	No	Invasive non-native species have been scoped out from further assessment.

SCOPING: RIVER AERON WATER BODY

Water body[1]	Description, notes or more information
WFD water body name	River Aeron
Water body ID	GB110063041450
River basin district name	Western Wales
Water body type (estuarine or coastal)	Surface water
Water body total area (ha)	12.15km^2
Overall water body status (2018)	Moderate
Ecological status	Moderate
Chemical status	Good
Target water body status and deadline	Good by 2027
Hydromorphology status of water body	High/Supports Good
Heavily modified water body and for what use	No
Higher sensitivity habitats present	No
Lower sensitivity habitats present	Yes
Phytoplankton status	N/A
History of harmful algae	Not stated
WFD protected areas within 2km	Yes

Specific risk information

The potential risks of the Scheme on each of the following receptors has been considered: hydromorphology, biology (habitats and fish), water quality, protected areas and invasive non-native species (INNS).

Section 1: Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status	Requires impact assessment	~~Impact assessment not required~~	Yes - This is a high status water body. The operation of the flood gate could impact on the hydromorphological regime in the harbour. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events. During construction the temporary cofferdam at Pwll Cam could also impact on river flows.
Could significantly impact the hydromorphology of any water body	Requires impact assessment	~~Impact assessment not required~~	Yes - The operation of the flood gate could impact on the hydromorphological regime in the harbour. The raising of the flood walls could also affect hydrology in terms of water levels and flows during storm events. During construction the temporary cofferdam at Pwll Cam could also impact on river flows.
Is in a water body that is heavily modified for the same use as your activity	~~Requires impact assessment~~	Impact assessment not required	No - This waterbody is not designated A/HMWB. The works will not impact on this status, and the influence of the breakwater beyond the harbour entrance will not affect hydromophology with the River Aeron waterbody.

Section 2: Biology

Habitats

Habitats of sensitivity considered include the following.

Higher sensitivity habitats	Lower sensitivity habitats
chalk reef	cobbles, gravel and shingle
clam, cockle and oyster beds	intertidal soft sediments like sand and mud
intertidal seagrass	rocky shore
maerl	subtidal boulder fields
mussel beds, including blue and horse mussel	subtidal rocky reef
polychaete reef	subtidal soft sediments like sand and mud
saltmarsh	
subtidal kelp beds	
subtidal seagrass	

Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5km^2 or larger	~~Yes, to one or more – requires impact assessment~~	No to all – impact assessment not required	No – The overall footprint of the Scheme activities is 0.04km^2. No higher or lower sensitivity habitats are located in the River Aeron.
1% or more of the water body's area			No – None of the works are located in the River Aeron waterbody.
Within 500m of any higher sensitivity habitat			No – Higher sensitive habitats are located over 500m from this waterbody.
1% or more of any lower sensitivity habitat			No – Scoped out from further assessment.

Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	~~Continue with questions~~	Go to next section	No – This waterbody is not an estuary.
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	Requires impact assessment	~~Impact assessment not required~~	Yes – the work will involve noisy activities including piling; and will take place in an area important for fish migration. There is a risk of fish entrapment both during construction and operation (see row below).
Could cause entrainment or impingement of fish	Requires impact assessment	~~Impact assessment not required~~	Yes – during construction the temporary cofferdam at Pwll Cam could cause fish entrapment. Following construction, the closure of the gate during storm events could also cause entrapment.

Section 3: Water quality

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	Requires impact assessment	~~Impact assessment not required~~	Yes – risk of chemical spills and leaks into the water.
Is in a water body with a phytoplankton status of moderate, poor or bad	~~Requires impact assessment~~	Impact assessment not required	Not assessed for this water body.
Is in a water body with a history of harmful algae	~~Requires impact assessment~~	Impact assessment not required	Not yet assessed for this water body

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list	Requires impact assessment	~~Impact assessment not required~~	Intrusive ground investigations were undertaken by (WYG, 2019) and (Quantum Geotechnical, 2021). Both investigations determined that no visual or olfactory evidence of contamination was evident. Chemical analysis has been undertaken of 8 soil samples and the results should be assessed.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	~~Impact assessment not required~~	Intrusive ground investigations were undertaken by (WYG, 2019) and (Quantum Geotechnical, 2021). Chemical

			analysis has been undertaken of 8 soil samples and the results should be assessed against Cefas Action Levels.

If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	Yes	No	Water quality risk issue(s)
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list	~~Requires impact assessment~~[5]	Impact assessment not required	No chemicals will be released during construction or operation.

Section 4: WFD protected areas

Protected area types considered include the presence of the following.

• special areas of conservation (SAC)	• bathing waters
• special protection areas (SPA)	• nutrient sensitive areas
• shellfish waters	

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2km of any WFD protected area	~~Requires impact assessment~~	Impact assessment not required	No – there are no Protected Areas within this waterbody in the vicinity of the works.

			Drinking water Protected Area, Shellfish Waters and Bathing Waters are all present but >2km from the proposed activity. Risk of impacts is considered negligible.

Section 5: Invasive non-native species (INNS)

Risks of introducing or spreading INNS include:

- materials or equipment that have come from, had use in or travelled through other water bodies
- activities that help spread existing INNS, either within the immediate water body or other water bodies

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	~~Requires impact assessment~~	Impact assessment not required	No – INNS have not been recorded on the site to date. Construction activities will be managed to avoid the introduction of INNS from plant and machinery used in other locations.

Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	Construction – Temporary cofferdam could affect river flows and hydromorphology. Operation – Closure of the flood gate at Pwll Cam could affect river flows and processes. The raising of the flood walls could also affect hydromorphology in terms of water levels and flows during storm events.
Biology: habitats	No	There are no sensitive habitats within this waterbody that are within close proximity to the Scheme.
Biology: fish	Yes	Construction – potential impacts from noise/vibration particularly during piling operations. Potential disturbance to migration up/downstream. Risk of entrapment from erection of temporary cofferdam during the Pwll Cam works. Operation – Risk of entrapment in Pwll Cam when the flood gate is closed during storm events.
Water quality	Yes	Construction - Risk of chemical spills and leaks into the water.
Protected areas	No	Protected areas have been scoped out.
Invasive non-native species	No	INNS have been scoped out from further assessment.

Appendix B. Chemical Screening

Assessment Criteria :	Coastal and Estuarine EQS												
CaCO (mg/l):	0.00		pH	0.00									
Calcium (mg/l):	0.00		DOC (mg/l)	0.00		Catchment area:	Freshwater not listed						
									Location				
									Sample ID		TP109	TP109	TP110	TP111
									Depth		0.1m	2m	0.2m	1m
									Date		17/11/2020	17/11/2020	30/11/2020	30/11/2020
Constituents	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedences	Locations of Exceedences	Strata	Zone				
pH		N/A	7 - 9.0	4	8.1	8.7	0				8.5	8.7	8.7	8.1
Electrical Conductivity	µS/cm	1	No WSV	4	79	2400	0				2400	690	79	110
Chloride	mg/l	1	N/A	4	7.1	660	0				660	130	7.1	17
Ammonium	mg/l	0.05	Not appropriate, see Unionised Ammonia	4	0.068	2.9	0				2.9	0.12	0.078	0.068
Phosphorus (Total)	mg/l	0.02	No WSV	4	0.026	0.5	0				0.5	0.04	0.026	0.29
Phosphate as P	mg/l	0.05	No WSV	4	<0.05	0.49	0				0.49	<0.05	<0.05	0.28
Sulphate	mg/l	1	N/A	4	<1	45	0				19	45	<1	9.6
Cyanide (Total)	mg/l	0.05	N/A	4	<0.05	<0.05	0				<0.05	<0.05	<0.05	<0.05
Cyanide (Free)	mg/l	0.05	0.001	4	<0.05	<0.05	0				<0.05	<0.05	<0.05	<0.05
Sulphide	mg/l	0.05	No WSV	4	<0.05	<0.05	0				<0.05	<0.05	<0.05	<0.05
Calcium	mg/l	5	N/A	4	<5	34	0				14	6.1	<5	34
Potassium	mg/l	0.5	N/A	4	<0.5	27	0				27	6	<0.5	2.4
Magnesium	mg/l	0.5	N/A	4	<0.5	30	0				30	7.6	<0.5	8.7
Sodium	mg/l	0.5	N/A	4	5.6	390	0				390	90	5.6	20
Arsenic (Dissolved)	mg/l	0.001	0.025	4	0.0012	0.054	1	TP109, 0.1m			0.054	0.0041	0.0012	0.004
Boron (Dissolved)	mg/l	0.02	No WSV	4	<0.02	0.3	0				0.3	0.11	<0.02	0.093
Barium (Dissolved)	mg/l	0.005	No WSV	4	<0.005	<0.005	0				<0.005	<0.005	<0.005	<0.005
Beryllium (Dissolved)	mg/l	0.001	No WSV	4	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001
Cadmium (Dissolved)	mg/l	0.00008	0.0002	4	<0.00008	0.00015	0				<0.00008	<0.00008	<0.00008	0.00015
Cobalt (Dissolved)	mg/l	0.001	No WSV	4	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001
Chromium (Dissolved)	mg/l	0.001	See Cr VI as first pass	4	<0.001	0.0058	0				0.0058	0.0019	<0.001	0.004
Copper (Dissolved)	mg/l	0.001	0.00376	4	<0.001	0.0067	1	TP111, 1m			0.0018	<0.001	<0.001	0.0067
Mercury (Dissolved)	mg/l	0.0005	0.00007	4	<0.0005	<0.0005	0				<0.0005	<0.0005	<0.0005	<0.0005
Manganese (Dissolved)	mg/l	0.001	N/A	4	0.0081	0.2	0				0.2	0.033	0.0081	0.034
Molybdenum (Dissolved)	mg/l	0.001	No WSV	4	<0.001	0.0078	0				0.0072	0.0078	<0.001	<0.001
Nickel (Dissolved)	mg/l	0.001	0.0086	4	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001
Lead (Dissolved)	mg/l	0.001	0.0013	4	<0.001	0.0094	1	TP111, 1m			<0.001	<0.001	<0.001	0.0094
Antimony (Dissolved)	mg/l	0.001	No WSV	4	<0.001	0.0015	0				0.0015	<0.001	<0.001	<0.001
Selenium (Dissolved)	mg/l	0.001	N/A	4	<0.001	0.0066	0				0.0066	0.0018	<0.001	<0.001
Tin (Dissolved)	mg/l	0.001	No WSV	4	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001
Vanadium (Dissolved)	mg/l	0.001	No WSV	4	<0.001	0.0053	0				0.0053	0.0011	<0.001	0.0023
Zinc (Dissolved)	mg/l	0.001	0.0079	4	<0.001	0.0054	0				<0.001	0.002	0.0032	0.0054
Iron (Dissolved)	mg/l	0.02	1	4	0.04	1.2	1	TP111, 1m			0.074	0.04	0.28	1.2
Low-Level Chromium (Hexavalent)	mg/l	0.0001	No WSV	4	<0.0001	<0.0001	0				<0.0001	<0.0001	<0.0001	<0.0001
Total Phenols	mg/l	0.03	No WSV	4	<0.03	<0.03	0				<0.03	<0.03	<0.03	<0.03

ATKINS CatWasteSoil

Classification Assessment Tool of Soil Wastes - Hazard Summary Sheet

Site Name	Aberaeron
Location	Carmarthenshire
Site ID	
Job Number	
Date	3/3/2021
User Name	Mark.Boobyer@atkinsglobal.com
Company Name	Atkins

Hole ID	Sample Depth	Hazardous Waste Y/N	HP1	HP2	HP3	HP4	HP5	HP6	HP7	HP8	HP9	HP10	HP11	HP12	HP13	HP14	HP15	HP16
TP100	1	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP109	0.1	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP109	0.3	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP109	2	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP110	0.2	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP110	1	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP111	0.2	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
TP111	1	N	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Assessment Criteria :	Public Open Space (Parks) - 1% SOM Sand																
Use MRL Values?																	
									Location								
									Sample ID		TP100	TP109	TP109	TP109	TP110	TP110	TP111	TP111
									Depth		1m	0.1m	0.3m	2m	0.2m	1m	0.2m	1m
									Date		17/11/2020	17/11/2020	17/11/2020	17/11/2020	30/11/2020	30/11/2020	30/11/2020	30/11/2020
									Strata									
Constituent	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedances	Locations of Exceedances		Zone								
ACM Type		N/A	No SSV	0	-	-	0				-	-	-	-	-	-	-	-
Asbestos Identification		N/A	No SSV	8	-	-	0				No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage		N/A	No SSV	0	-	-	0				-	-	-	-	-	-	-	-
Moisture	%	0.02	No SSV	8	2.5	43	0				3.7	43	6	6.7	5.2	2.5	7.3	4.2
pH		4	No SSV	8	8.1	8.8	0				8.5	8.1	8.4	8.3	8.4	8.8	8.7	8.8
Boron (Hot Water Soluble)	mg/kg	0.4	No SSV	8	0.8	3.7	0				2.1	3.7	2	2.2	1	0.8	2.5	1.9
Sulphur (Elemental)	mg/kg	1	No SSV	8	8.3	1800	0				83	1800	8.3	290	18	23	250	42
Nitrite (Extractable)	mg/kg	0.1	No SSV	8	<0.1	0.22	0				<0.1	<0.1	<0.1	<0.1	0.13	<0.1	0.22	<0.1
Nitrate (Water Soluble)	g/l	0.01	No SSV	8	<0.01	<0.01	0				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cyanide (Free)	mg/kg	0.5	34	8	<0.5	<0.5	0				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyanide (Total)	mg/kg	0.5	No SSV	8	<0.5	<0.5	0				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide (Easily Liberatable)	mg/kg	0.5	No SSV	8	2.1	9.3	0				3.1	3.7	2.6	9.3	2.4	2.1	4.8	2.3
Ammonium (Extractable)	mg/kg	0.5	No SSV	8	1.9	24	0				2.2	24	1.9	2.7	3.2	2.3	2.6	2.9
Ammoniacal Nitrogen	mg/kg	0.5	No SSV	8	1.5	19	0				1.7	19	1.5	2.1	2.5	1.8	2	2.3
Ammonium (Water Soluble)	g/l	0.01	No SSV	8	<0.01	<0.01	0				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphate (Total)	mg/kg	100	No SSV	8	410	13000	0				540	13000	410	2800	2100	550	1900	410
Arsenic	mg/kg	1	168	8	12	19	0				12	15	18	17	19	12	14	14
Beryllium	mg/kg	1	61	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	mg/kg	0.1	882	8	<0.1	0.1	0				<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	mg/kg	1	83500	8	18	30	0				21	30	21	28	18	23	22	25
Manganese	mg/kg	5	No SSV	8	580	4000	0				780	630	2600	1100	4000	580	930	1100
Antimony	mg/kg	2	3090	8	<2	<2	0				<2	<2	<2	<2	<2	<2	<2	<2
Copper	mg/kg	0.5	45200	8	19	68	0				27	21	68	26	47	19	34	32
Mercury	mg/kg	0.1	No SSV	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	0.5	804	8	31	44	0				32	33	37	44	33	31	36	38
Lead	mg/kg	0.5	1340	8	12	79	0				25	25	39	29	79	12	31	27
Selenium	mg/kg	0.2	2550	8	<0.2	0.23	0				0.23	0.21	<0.2	<0.2	0.22	<0.2	<0.2	<0.2
Vanadium	mg/kg	5	1550	8	19	35	0				19	35	19	27	20	21	24	24
Zinc	mg/kg	0.5	201000	8	81	130	0				99	110	110	110	130	81	120	100
Chromium (Hexavalent)	mg/kg	0.5	251	8	<0.5	<0.5	0				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fraction of Organic Carbon		0.001	No SSV	8	<0.001	0.015	0				<0.001	0.015	<0.001	0.0013	0.0059	0.0033	0.0024	0.0034
Organic Matter	%	0.4	No SSV	8	<0.4	2.6	0				<0.4	2.6	<0.4	<0.4	1	0.57	0.41	0.59
Aliphatic TPH >C5-C6	mg/kg	1	109000	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C6-C8	mg/kg	1	163000	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C8-C10	mg/kg	1	9720	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C10-C12	mg/kg	1	17700	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C12-C16	mg/kg	1	23800	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C16-C21	mg/kg	1	864000	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C21-C35	mg/kg	1	864000	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C35-C44	mg/kg	1	No SSV	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Total Aliphatic Hydrocarbons	mg/kg	5	No SSV	8	<5	<5	0				<5	<5	<5	<5	<5	<5	<5	<5
Aromatic TPH >C5-C7	mg/kg	1	139	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C7-C8	mg/kg	1	69900	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C8-C10	mg/kg	1	5140	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C10-C12	mg/kg	1	8260	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C12-C16	mg/kg	1	10600	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C16-C21	mg/kg	1	No SSV	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C21-C35	mg/kg	1	7870	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Aromatic TPH >C35-C44	mg/kg	1	No SSV	8	<1	<1	0				<1	<1	<1	<1	<1	<1	<1	<1
Total Aromatic Hydrocarbons	mg/kg	5	No SSV	8	<5	<5	0				<5	<5	<5	<5	<5	<5	<5	<5
Total Petroleum Hydrocarbons	mg/kg	10	No SSV	8	<10	<10	0				<10	<10	<10	<10	<10	<10	<10	<10
Naphthalene	mg/kg	0.1	623	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	No SSV	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	28600	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	19600	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	No SSV	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	150000	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	20200	8	<0.1	0.47	0				<0.1	<0.1	<0.1	0.13	<0.1	<0.1	0.47	<0.1
Pyrene	mg/kg	0.1	15100	8	<0.1	0.42	0				<0.1	<0.1	<0.1	0.15	<0.1	<0.1	0.42	<0.1
Benzo[a]anthracene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[b]fluoranthene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[k]fluoranthene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[a]pyrene	mg/kg	0.1	21.4	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)Pyrene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)Anthracene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo[g,h,i]perylene	mg/kg	0.1	BaP Surrogate	8	<0.1	<0.1	0				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Of 16 PAH's	mg/kg	2	No SSV	8	<2	<2	0				<2	<2	<2	<2	<2	<2	<2	<2
Benzene	mg/kg	0.001	139	8	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	mg/kg	0.001	69900	8	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	mg/kg	0.001	21400	8	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
m & p-Xylene	mg/kg	0.001	No SSV	8	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	mg/kg	0.001	9560	8	<0.001	<0.001	0				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Phenols	mg/kg	0.3	No SSV	8	<0.3	<0.3	0				<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3

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