EcoVigour
Integrated Environmental Management

2020

Barmouth Viaduct Refurbishment

Water Framework Directive Assessment

GRIFFITHS
civil engineering and construction

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1. Introduction

1.1.1 EcoVigour Ltd were commissioned by Griffiths Rail, on behalf of Network Rail, to undertake a Water Framework Directive (WFD) Assessment for the proposed Barmouth Rail Viaduct Refurbishment.

1.1.2 The purpose of this report is to assess the impacts of the scheduled refurbishment works associated with the Proposed Scheme against the WFD parameters for the Mawddach Estuary, its associated tributaries, the Cardigan Bay North Coastal Area and the Meirionnydd Groundwater Area. This assessment includes a summary of the current local conditions and, where appropriate, identifies mitigation measures for any likely significant effects (LSE) that may arise as part of the construction and operation of the Proposed Scheme.

1.1.3 This WFD Assessment is required to demonstrate that the proposed works will not result in deterioration of the Mawddach Estuary, the adjoining Lleyn Peninsula Special Area of Conservation (SAC) and Mawddach Estuary Site of Special Scientific Interest (SSSi)

1.1.4 Barmouth Rail Viaduct is within the boundaries of the Lleyn Peninsula Special Area of Conservation (SAC), and Afon Mawddach Estuary Site of Special Scientific Interest (SSSI). Therefore, the main statutory designated sites which require consideration under the assessment have been identified as:

- Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau (PLAS) Special Area of Conservation (SAC).
- Mawddach Estuary Site of Special Scientific Interest (SSSI).

1.1.5 There are several watercourses flowing into the estuary. The principal rivers are the Afon Mawddach from the north, the Afon Wnion from the east. The Gwynant flows into the estuary from the south and the Cwn-Mynach, Cwm-Llechen and Dwynant from the north. All of these enter the estuary upstream of the viaduct.

1.2 Project Background

1.2.1 The Barmouth Viaduct Refurbishment project concerns the refurbishment of the existing timber section of the historic rail viaduct across the estuary. Completed in 1867, the structure is a Grade II listed single-track wooden railway viaduct, carrying the Cambrian line across the Afon Mawddach Estuary South of Barmouth, Wales. It is the longest timber viaduct of its kind in Wales and one of the oldest still in regular use in Britain.

1.2.2 In 2019 Network Rail commissioned a condition survey of the timber viaduct UB40 and this identified the need to replace a substantial number of timber elements. In addition to this, there are also numerous metal bolts, and straps that have corroded and will need to be replaced.

1.2.3 Consequently, the scheme requires the replacement of approximately 2394 structural members, including 124 main beams, 58 edge beams, 22 pedestrian walkway beams and 50 piles. Associated stainless steel straps and bolts plus other identified strap replacements. Repairs and replacement of existing concrete shrouds around piles. Areas at both the northern and southern ends of the bridge will be utilised as site compounds, comprising offices, parking, materials storage and access for plant.

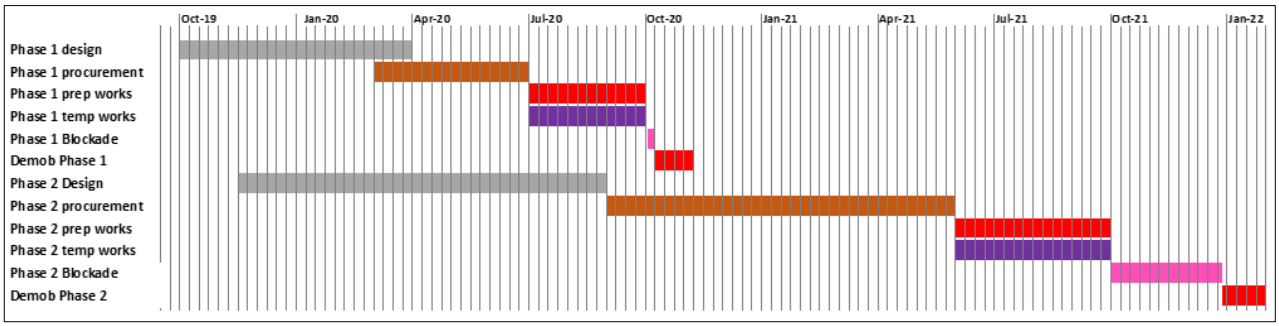

Figure 1: Project Program Overview

1.2.4 Due to the scale and complexity of the project. The scheme has been split into two distinct phases which will be delivered by means of extensive preparation works during low tide conditions from July/August 2020. This will allow as much work as possible to be accomplished outside of the two arranged rail blockades. Phase 1 rail blockade scheduled for mid-October 2020 for 16 days and Phase 2 from mid-September 2021 for 90 days respectively (see figure 1 for general project program overview).

1.2.5 Phase I is due to commence in June 2020, and will include the necessary compound setup at Morfa Mawddach (Site 1) for use as office / welfare facilities, storage of required plant, machinery and materials, preparation works to the below estuary bed level piles (installation of new gabion baskets within the existing reno mattress foundation around the existing piles), replacement of crosshead timbers and the rapid replacement of the piles using the previously installed gabions during the first blockade.

1.2.6 Phase II will feature additional preparations to the structure prior to the main rail blockade during October 2021 which will include the replacement of vertical sections of the viaduct piers, replacement of concrete shrouds around the base of the piers and upper deck repairs/refurbishment. Demobilisation of all project assets is scheduled for January 2022.

1.2.7 Further details of these project tasks is provided in the following methodology section 4.

2. Introduction to the Water Framework Directive

2.1.1 The Water Framework Directive (WFD) (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000) is a European Union Directive which committed member states to achieve good qualitative and quantitative status of all water bodies by 2015. Under the Directive water bodies are defined as all ground and surface waters, including rivers, lakes, transitional waters and coastal waters (up to one nautical mile from shore).

2.1.2 It was not possible to achieve good status of all water bodies by 2015; therefore, outstanding water bodies have objectives set for 2021 or 2027.

2.1.3 The WFD is transposed into law in England and Wales by The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 2017 Regulations). These revokes and replace The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (subject to transitional provisions in article 38 of the 2017 Regulations).

2.2 Determination of Good Status

2.2.1 Good status is determined from the ecological and chemical status of surface waters. These statuses are assessed according to the following criteria:

- Biological quality (fish, benthic invertebrates, aquatic flora);
- Hydromorphological quality (e.g. riverbank structure, river continuity and substrate of the riverbed); and
- Physical-chemical quality (e.g. temperature, oxygenation and nutrient conditions).

2.2.2 The chemical quality refers to environmental quality standards for river basin specific pollutants. These standards specify maximum concentrations for specific water pollutants. The WFD works on a 'one out, all out' basis, so if one such concentration is exceeded, then the water body will not be classed as having a good status. The chemical status of surface waters is therefore classified as good or fail.

2.2.3 The ecological status of surface waters is classified as being high, good, moderate, poor or bad, whilst water bodies that have been modified (e.g. canals or contain significant flood defences) are classed as 'Heavily Modified Water bodies' (HMWB) and have to reach at least good potential by their objective year.

2.3 Water Framework Directive Assessments

2.3.1 WFD Assessments are undertaken to demonstrate that proposed works (either at strategy level or detailed design/implementation stage) can be undertaken without impacting the status of water bodies or preventing future works to enable the water bodies to achieve good status/potential.

2.3.2 Determination of WFD compliance comprises a series of steps intended to establish the potential impacts of the Proposed Scheme (at an appropriate level of detail) and then to examine whether the identified impacts contravene the conditions of the WFD.

2.3.3 The following assessment objectives (derived from the Environmental Objectives of the Directive) are used to determine whether the planned development, in and around the water environment, which is affected by the Proposed Scheme, comply with the overarching objectives of the WFD:

- Objective 1: To prevent deterioration in the ecological status of the water body;
- Objective 2: To prevent the introduction of impediments to the attainment of good WFD status for the water body, or maintaining good status for water bodies which have attained this;
- Objective 3: To ensure that the attainment of the WFD objectives for the water body are not compromised; and
- Objective 4: To ensure the achievement of the WFD objectives in other water bodies within the same catchment are not permanently excluded or compromised.

2.3.4 The assessment process is as follows:

- Screening of the preferred option against the ecological, chemical and quantitative status objectives and elements to determine if the project has any impact on the criteria identified for any water bodies;
- Detailed assessment for those criteria where a potential adverse effect has been identified to determine the effects on quality elements;
- Identified impacts are then considered in relation to the ecological and supporting chemical and hydromorphological status objectives;
- For HMWBs the preferred option is then also assessed against their relevant mitigation measures; and
- Article 4.7 test, if the preferred option is predicted to cause deterioration in water body status or prevent the water body from meeting any of its objectives, then assessment is required against the conditions listed in WFD Article 4.7, all of which must be met for the preferred option to proceed without contravening the WFD. The impact of the scheme on other water bodies within the River Basin District must also be considered (Article 4.8) and protection given by existing Community legislation to any Protected Areas must also be maintained (Article 4.9).

2.4 Assessment Methodology

2.4.1 This WFD Assessment was completed using the following methodology:

- The collection of baseline data to identify the current status, as well as future baseline and ability of the water bodies within and in close proximity to the proposed works to meet the WFD objectives;
- A Consultation with relevant authorities;
- The review of the proposed works and the potential impacts to the identified surface and groundwater bodies; this involves identifying the impacts that could reduce the WFD status and affect the ability of the water bodies to meet the objectives of the WFD;
- The consideration of mitigation that can be included in the design, and
- The provision of an assessment of residual risks.

3. Viaduct Refurbishment – Objectives, Timing & Locations

3.1.1 The refurbishment of the viaduct requires a substantial number of timbers and support components to be replaced over a 2 year period in two distinct Phases of work.

3.1.2 Below is a summary of works required to refurbish the structure and timetable of projected land access requirements during the individual phases:

- Setup of site compounds north and south of the structure with smaller satellite compound for welfare facilities directly north of the structure.
- Replacement of 2,394 structural timber members, including 124 main beams, 58 edge beams and 22 pedestrian walkway beams.
- The replacement of 50 piles & 64 crosshead timbers, corbels, with a new Glass-Reinforced Plastic (GRP) to the Up-cess trackside maintenance walkway & new parapet hand railing.
- The replacement of associated stainless-steel straps and bolts plus other identified strap replacements
- The replacement of concrete surround to piles riverside.
- Full longitudinal timber and rail replacement across the structure
- New track guard panels at either end of structure

Table 1: The following table detailed the project dates with Phases I & II

Site Description	Purpose	Phase 1 Start Date	Phase 1 End Date	Phase 2 Start Date	Phase 2 End Date	Approximate area required
Site 1, Morfa	Office, welfare & materials store.	08/06/20	27/11/20	07/07/21	28/01/22	150m x10m 200m x 50m
Site 2 Oriental Gardens	Office & welfare	08/06/20	27/11/20	07/07/21	28/01/22	35m x 8m
Site 3 Main car park	Office & car park.	28/09/20	27/11/20	27/09/21	28/01/22	50m x 70m
Site 4 Marine Parade	Main office, welfare & materials store.	08/06/20	27/11/20	07/07/21	28/01/22	160m x 50m
Site 5 Car Park	Car park	08/06/20	27/11/20	07/07/21	28/01/22	160m x 12m

Temporary site compounds will be established at the following locations

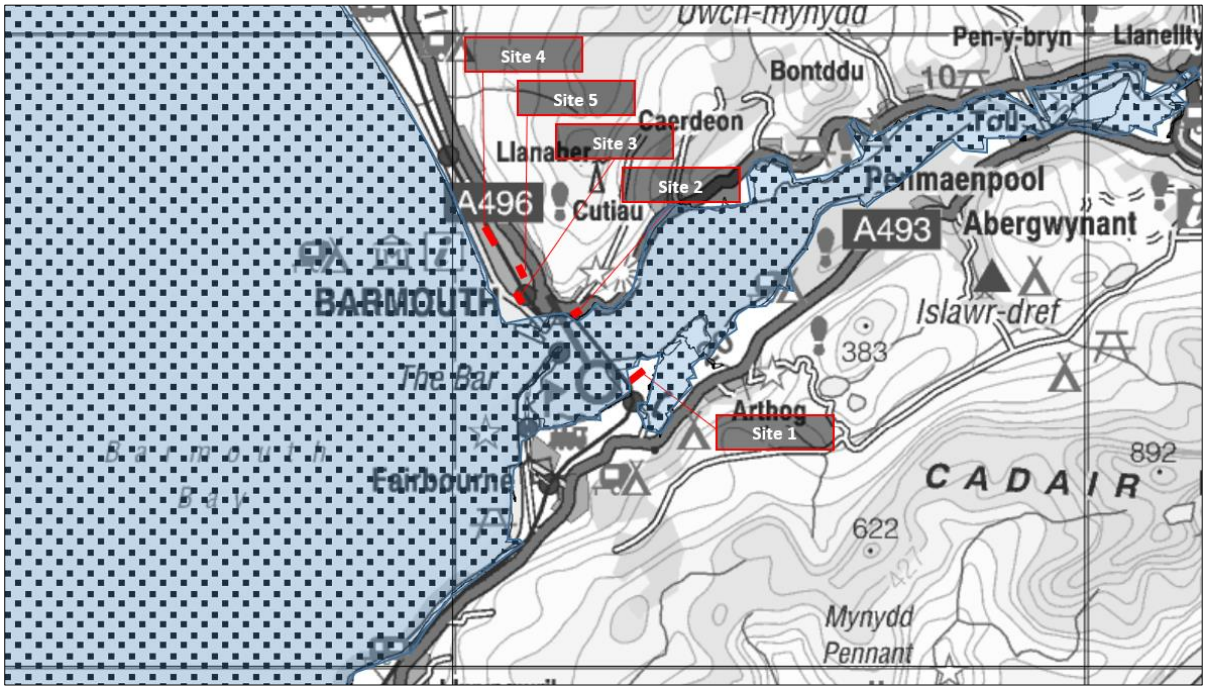

Figure 2: Location of proposed compound sites in relation to SAC & SSSI.

Table 2: Sites description in relation to SAC/SSSI proximity and Ecological Sensitivity.

Site	Works Required to Setup	Proximity to SAC/SSSI	WFD Ecological Sensitivity
Site 1- Morfa	Office, welfare & materials store.	Close Proximity to SAC/SSSI: within connected habitat, surrounded by designated site boundaries.	High
Site 2 - Oriental Gardens	Office & welfare	Outside of SAC/SSSI: Within footprint of existing hard standings within public gardens.	Low
Site 3 - Main car park	Office & car park.	Outside of SAC/SSSI: Within footprint of existing small pay and display car park.	Low
Site 4 - Marine Parade	Main office, welfare & materials store.	Outside of SAC/SSSI: Disused hard standing and gravel surface area with existing Road Rail Access Point (RRAP)	Low
Site 5 - Car Park	Car park	Outside of SAC/SSSI: Similar to Site 3, footprint within existing car park area.	Low

3.1.3 For the purpose of this assessment, only the temporary compound at Morfa Mawddach will be considered as the remainder of the compounds are within areas which have been previously developed, are removed from the estuary and will not require major development works.

3.1.4 The following illustrations detail the compound locations and proposed access routes.

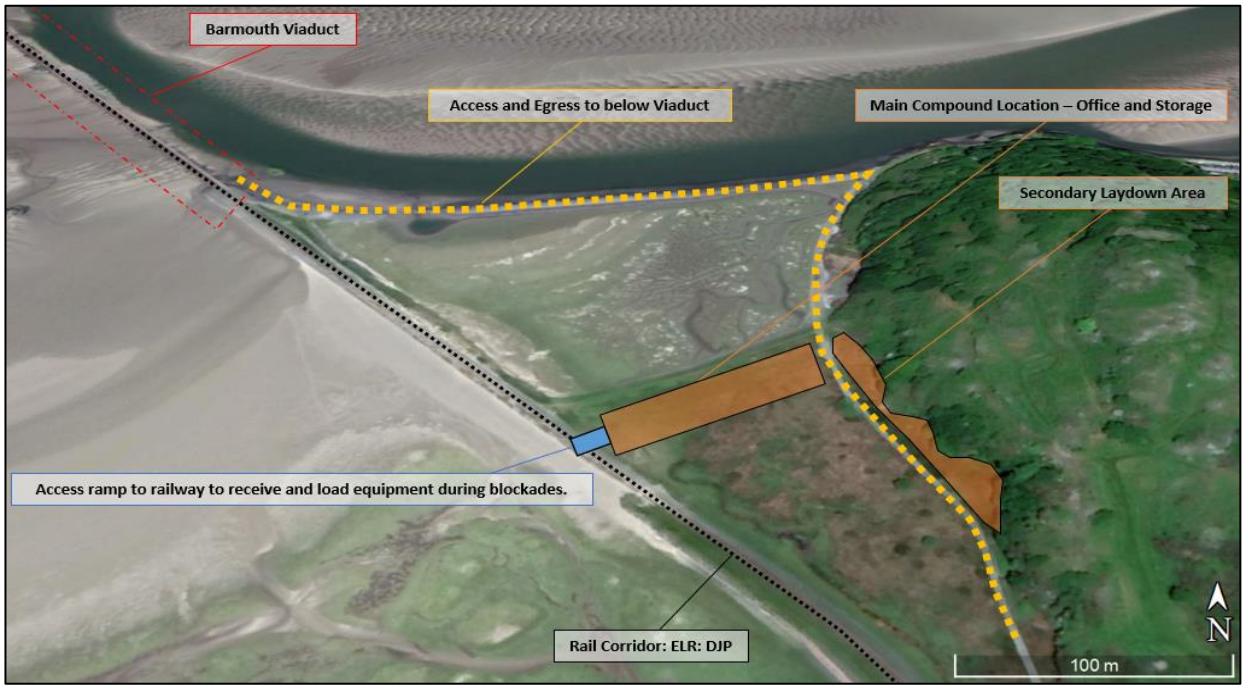

Figure 3: Site 1 Morfa General Layout

4. Baseline Conditions

4.1.5 This assessment has been prepared following WFD screening/scoping assessment guidance provided by the Environment Agency / NRW.

4.1.6 There are nine WFD surface waterbodies in the proximity of the proposed scheme: Mawddach Estuary (GB511006407100) but there are six rivers / watercourses flowing into the estuary. The Mawddach Lower (GB110064048710) from the north, the Afon Wnion (GB110064048800) from the east. The Gwynant (GB110064048660) flows into the estuary from the south and the Cwn-Mynach (GB110064048820), Cwm-Llechen (GB110064048810) and Dwynant (GB110064048700) from the north. Works will only be undertaken within the Mawddach Estuary and impacts on the other waterbodies are unlikely.

4.1.7 Table 17 (below) presents summary information on the current WFD status of each of the constituent quality elements of the waterbodies under consideration. This information has been obtained from the Water Watch Wales website. Each of the quality elements will be assessed to determine whether the proposed scheme has the potential to adversely affect their status.

4.1.8 Only one groundwater waterbody, the Meirionnydd (GB41002G203200), is located within the project area. It has a Quantitative Status of Good and a chemical status of Poor, giving it an overall status of Poor. The potential for the proposed scheme to impact groundwater is considered in Section 7.

4.2 Description of the Study Area

4.2.1 The Barmouth Viaduct Refurbishment project is situated between the North and South shores of the Afon Mawddach Estuary (Grid Ref: SH 61961 15478 & SH 62443 14865 respectively). Several site compounds will be setup to service the scheme with office and welfare facilities, carparking and materials storage. The majority of the compounds will be situated within Barmouth remote from the estuary and the sea front and hence these will not be considered further by this assessment.

4.2.2 However, one site compound will be located to the South of the viaduct in Morfa Mawddach, West of Fegla Fawr (Grid Ref: SH 62736 14623). The presence of this compound has potential to impact the estuary and coastal waters, therefore will hence be assessed.

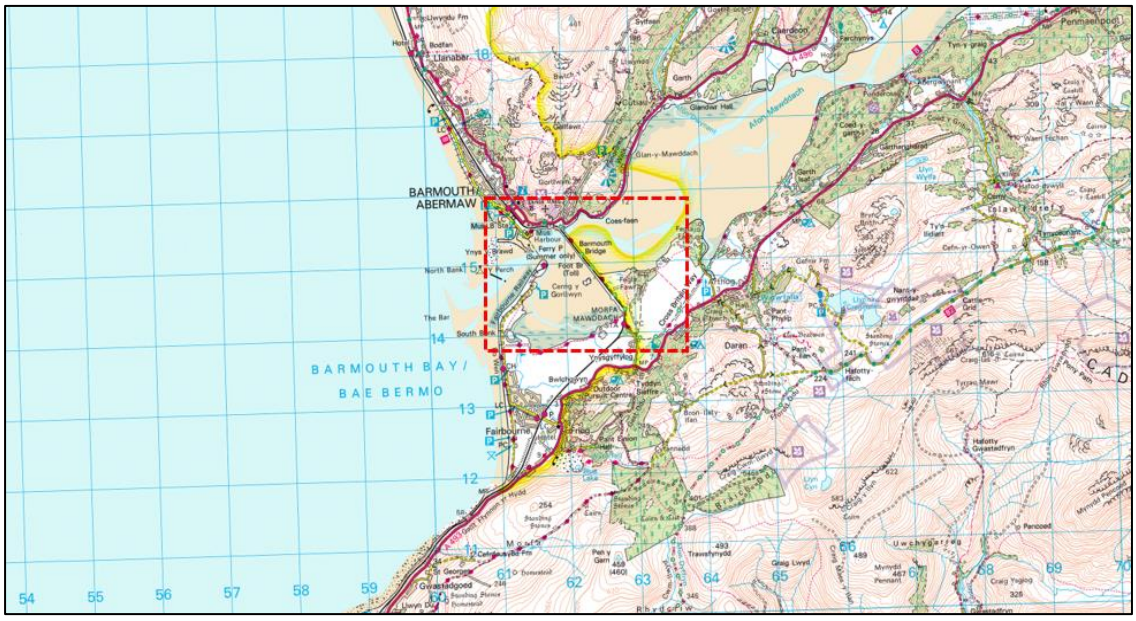

Figure 4: Project Location in context to the wider Area.

4.2.3 The Mawddach Estuary is principally fed by the Afon Mawdach but there are six rivers / watercourses flowing into the estuary. The Afon Mawddach from the north, the Afon Wnion from the east. The Gwynant flows into the estuary from the south and the Cwn-Mynach, Cwm-Llechen and Dwynant from the north. All of these enter the estuary upstream of the viaduct.

4.2.4 Mawddach Estuary is designated as a SSSI due to its diverse biological features. Situated west of Dolgellau in Meirionnydd, the site includes the Mawddach estuary itself, a large shallow estuary draining south westwards into Cardigan Bay, and adjacent habitats.

4.2.5 The estuary is wide with extensive sandflats throughout its length, areas of muddy sediments and large areas of saltmarsh. The mouth of the estuary is protected to the south by Fairbourne Spit, a sand and shingle spit, and on the north side is the small town of Barmouth.

4.3 Designated Sites within Proximity to Site

4.3.1 There are several statutory designated sites within a proximity to the section of sea wall.

4.3.2 Site of Special Scientific Interest:

- Afon Mawdachh (SSSI)
- Barmouth Hillside (SSSI)
- Ty Bach Ystlumod (SSSI)
- Glannau Tonfanau I Friog (SSSI)
- Arthog Hall Woods (SSSI)
- Cregennen a Pared y Cefn Hir (SSSI)

4.3.3 Special Area of Conservation:

- Lleyn Peninsula and the Sarnau (SAC)
- West Wales Marine (SAC)
- Meirionnydd Oakwoods and Bat Sites (SAC)

4.3.4 As Barmouth Hillside, Glannau Tonfanau I Friog, Arthog Hall Woods, Cregennen a Pared y Cefn Hir SSSI's are designated by their respective in situ features that are a significant distance from the project area. Meirionnydd Oakwoods and Bat Sites & Ty Bach Ystlumod are also not within the zone of influence of the estuary. These sites will not be considered further in this assessment. The remaining Lleyn Peninsula and West Wales (SAC) and Afon Mawdachh (SSSI) site will be considered further in the following sections.

4.3.5 The assessment recognises that sites such as Glannau Tonfanau I Friog (SSSI) would be sensitive to a large pollution event. However as pollution control measures will be implement for the remaining SAC & SSSI features, protection to this site and others further afield will be inferred from the measures to protect the main SAC & SSSI sites being discussed.

4.4 Afon Mawddach (SSSI)

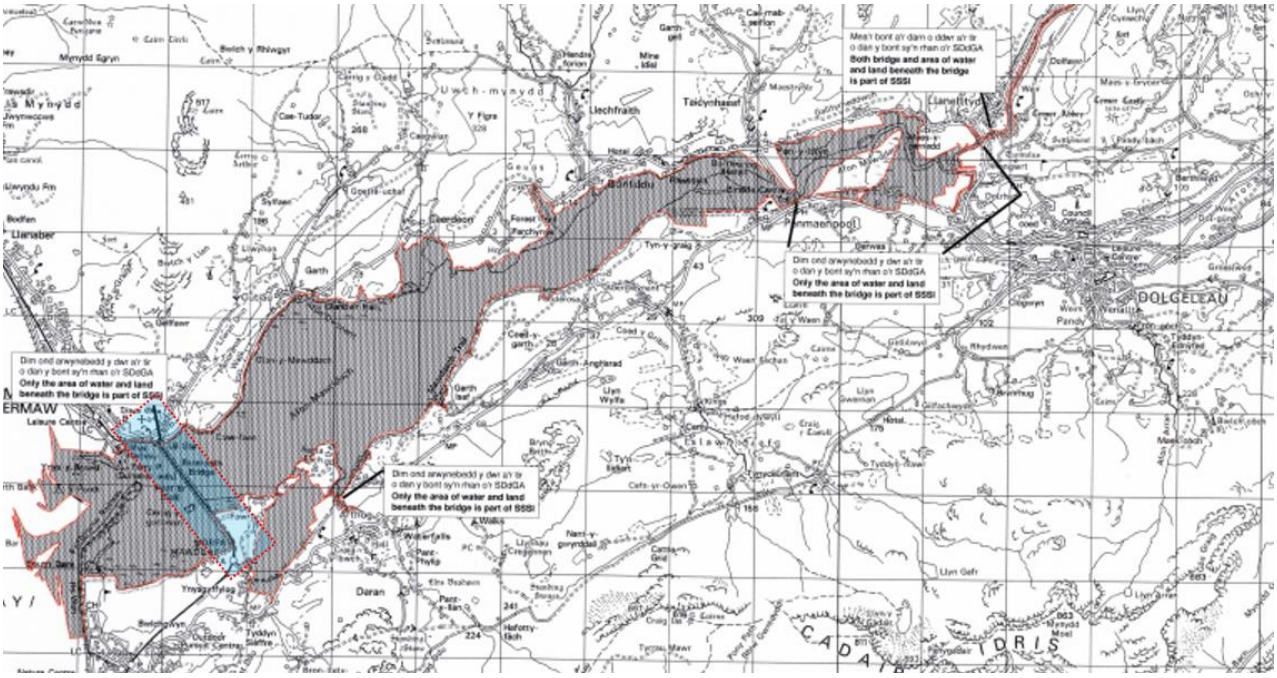

Figure 5: Project Location in relation to SSSI.

4.4.1 The special features of the site are the estuarine habitats, particularly muddy sediments, saltmarshes, reed beds and raised mire. There is also a substantial species interest, including breeding wading birds, scarce vascular plants, bryophytes and invertebrates

4.4.2 Within the Site Management Statement (SMS), the features below are listed which form the overall status of the designated site:

- The estuary
- Intertidal muddy gullies
- Bog
- Salt marsh
- Coastal fen
- Swamp
- Wet woodland
- Rare plants
- Otter
- Redshank and snipe
- River shingle invertebrates
- Rare liverwort
- Salmon

4.4.3 From the extended Phase I survey, the relevant habitat from the SMS in relation to the project area remaining are:

- The estuary
- Intertidal muddy gullies
- Salt marsh

4.4.4 There is a list of potential damage vectors to the designated site highlighted within the SMS Potentially Damaging Operations (PDO) list. Below are the activities considered relevant to the proposed project (Table 3 below).

Table 3: PDO list from NRW Designated Site Finder Tool.

SMS Ref No:	Type of operation
11.	Destruction, displacement, removal or cutting of any plant or plant remains, including tree, shrub, herb, hedge, dead or decaying wood, moss, lichen, fungus, leaf-mould, turf or peat.
12.	Tree and/or woodland management, the introduction of tree and/or woodland management and alterations to tree and/or woodland management including planting, felling, pruning and tree surgery, thinning, coppicing, changes in species composition and removal of fallen timber.
21.	Destruction, construction, removal, rerouting, or regrading of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, including soil and rock exposures.
22.	Storage of materials.
23.	Erection of permanent or temporary structures or the undertaking of engineering works, including drilling or the laying, maintenance or removal of pipelines and cables, above or below ground.
24.	Modification of natural or man-made features (including cave entrances) and clearance of boulders, large stones, loose rock or scree and the battering, buttressing or grading of geological exposures.
26.	Use of vehicles or craft.

4.4.5 The rare plant species reference in the SMS (e.g. lesser marshwort, lesser bulrush, cyperus sedge) were not found during the Phase I Habitat survey, this is not to suggest that these species are conclusively absent from the area, but the likelihood of encounter is lower.

4.4.6 Grimmia Arenaria and Pallavicinia lyellii moss and liverwort features appear to be highly localised to their described locations which are outside of the project footprint.

4.4.7 Mitigation measures for animal species such as otter which overlap SAC, Redshank, Snipe, River shingle invertebrates and Salmon are discussed further in section 13.

4.5 West Wales Marine (SAC)

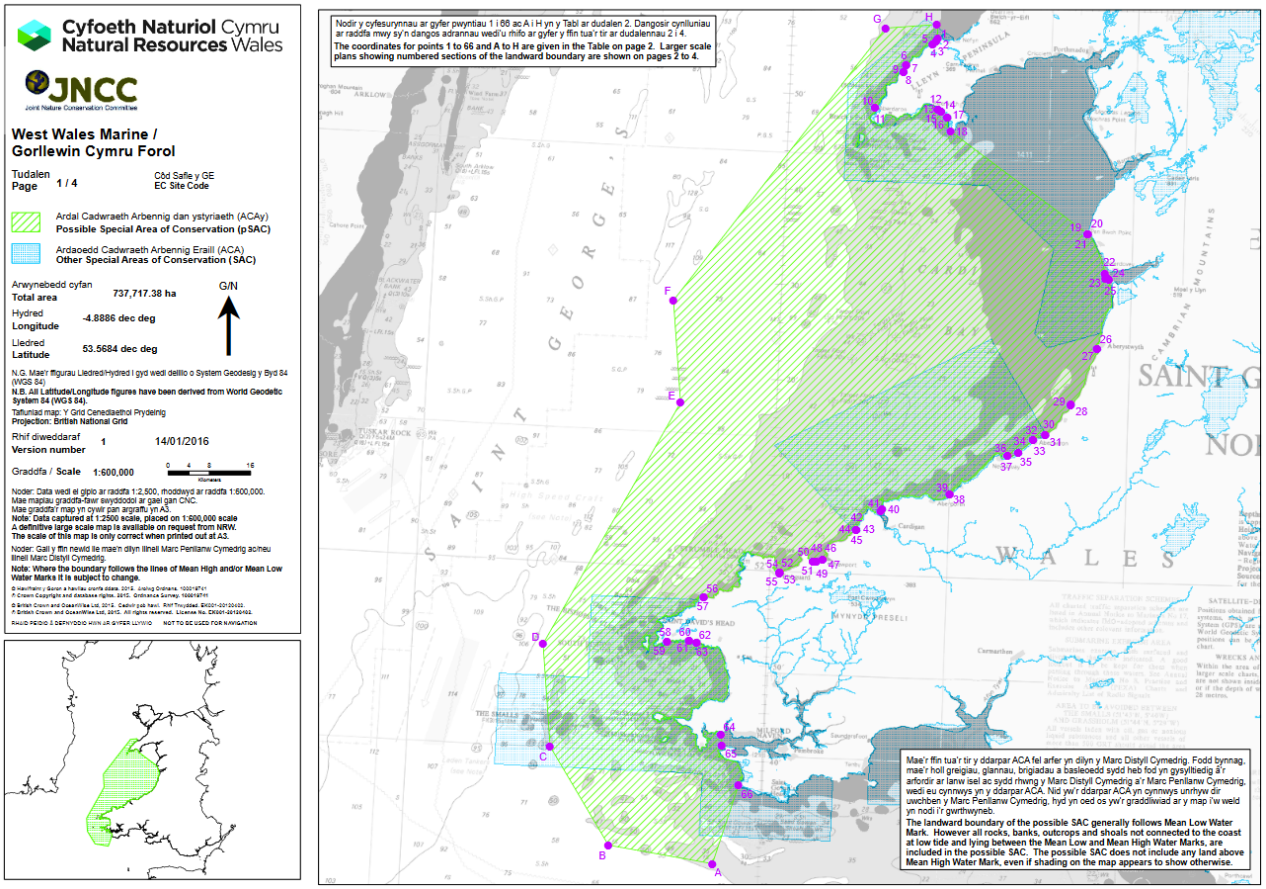

Figure 6: West Wales Marine site boundaries.

4.5.1 Designated in February 2019, the site is now at full SAC status. The Conservation Objectives (COs) and Advice on Activities (AoA) are set out for the West Wales Marine, Annex II (reason for designation) species harbour porpoise (Phocoena phocoena).

4.5.2 The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where Natural Resources Wales (NRW) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities.

4.5.3 The boundary of the SAC has been defined based on population modelling and habitat mapping. The range is based from winter and summer population movements.

4.5.4 As the boundary is based on the general range of the species it is unlikely that this species will be encountered and in turn impact the defining feature of this SAC.

4.5.5 The mitigation measures to be set in place regarding other Cetaceans within the PLAS SAC will be sufficient to infer protection to this species.

4.6 Lleyn Peninsula and the Sarnau (SAC)

4.6.1 The Lleyn Peninsula and the Sarnau SAC is comprised of sea, coast and estuary that supports a wide range of marine habitats and dependant wildlife. The nature of the seabed and coast including the range of environmental conditions present vary throughout the SAC. (See figure 3 for project location in relation to the SAC boundary). For the qualifying habitats and species listed in the table below (table 4), the Lleyn Peninsula and the Sarnau SAC is one of the best areas in the United Kingdom.

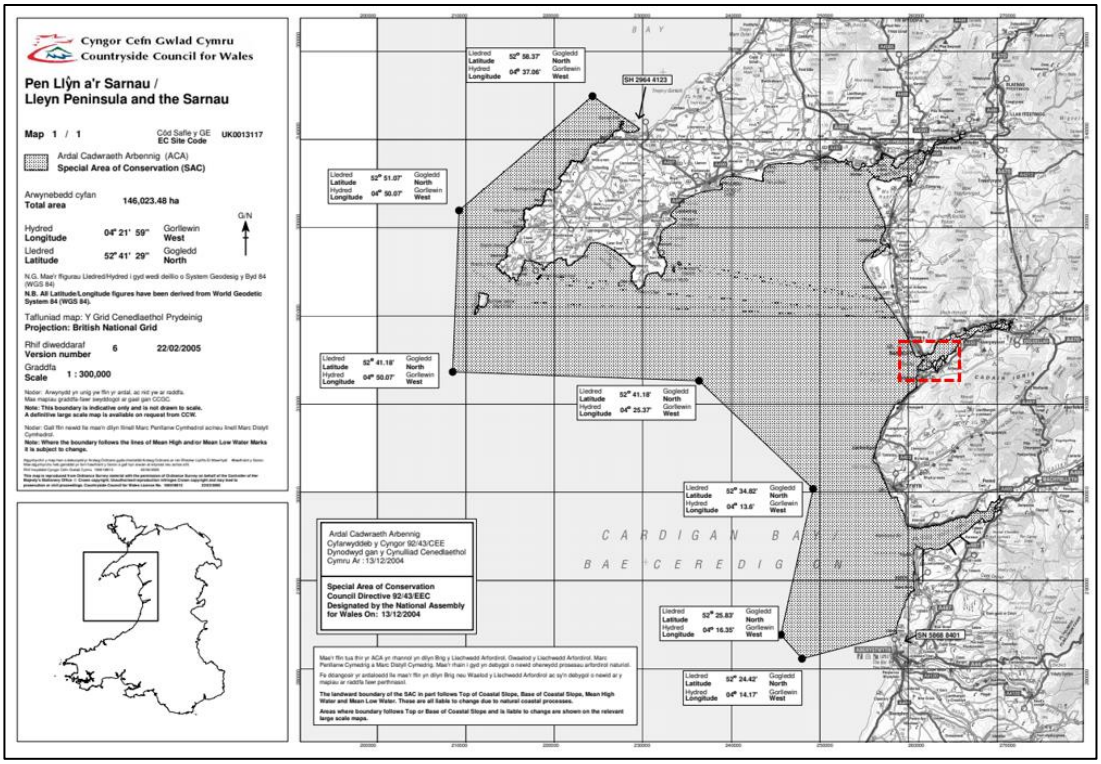

Figure 7: Boundary of SAC in relation to project area. West Wales Marine & Afon Mawddach boundaries overlap with Lleyn SAC.

Table 4: Annex I & II features of the PLAS SAC.

EU Code	Feature
Annex I habitats that are a primary reason for selection of this site	
1110	Sandbanks which are slightly covered by sea water all the time
1130	Estuaries
1150	Coastal lagoons (* Priority feature)
1160	Large shallow inlets and bays
1170	Reefs
Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site	
1140	Mudflats and sandflats not covered by seawater at low tide
1310	Salicornia and other annuals colonizing mud and sand
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
8330	Submerged or partially submerged sea caves
Annex II species present as a qualifying feature, but not a primary reason for site selection	
1349	Bottlenose dolphin (Tursiops truncates)
1355	Otter (Lutra lutra)
1364	Grey seal (Halichoerus grypus)

4.6.2 As the projected refurbishment works occur directly within the SAC, it is necessary to identify the Annex I & II features that will be found directly within the project footprint.

4.7 Annex I – NRW Indicative Condition Report

4.7.1 The tables below are extracted from the PLAS SAC - Indicative site level feature condition assessments 2018, NRW Evidence Report No: 234. These tables describe the current status the Annex I features relevant to the project.

Table 5: Reef Habitat Condition.

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Reefs				
Component of habitat feature assessed	Indicative Assessment (Favourable, unfavourable, unknown)	Key evidence type used (Monitoring data, reports or expert judgement)	Level of agreement	Confidence in evidence	Component confidence level
Distribution & Extent (within site)	Unfavourable	Monitoring data (limited) and expert judgement	High	Low	Low
Structure & function	Unfavourable	Monitoring data (limited), WFD data and expert judgement	High	Low	Low
Typical species	Unfavourable	Monitoring data (limited) and expert judgement	High	Low	Low
Relevant activities (activities directly impacting condition of the feature on this site)			Historic fishing damage, previous illegal activity has caused long term damage that has not yet recovered (see notes section). Water quality issues		
Overall Indicative Assessment			Overall Confidence Level		
Unfavourable			Low		

Table 6: Estuaries Habitat Condition.

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Estuaries				
Component of habitat feature assessed	Indicative Assessment (*Favourable, unfavourable, unknown*)	Key evidence type used (*Monitoring data, reports or expert judgement*)	Level of agreement	Confidence in evidence	Component confidence level
Distribution & Extent (within site)	Unfavourable	Some monitoring data, expert judgement	High	Medium	Medium
Structure & function	Unfavourable	Some monitoring data, WFD waterbody assessments, expert judgement	High	Low	Low
Typical species	Favourable	Some monitoring data, WFD data, expert judgement	High	Medium	Medium
Relevant activities (activities directly impacting condition of the feature on this site)			Historic pollutants Works on Pont Briwet and Dwyryd Pylon		
Overall Indicative Assessment			Overall Confidence Level		
Unfavourable			Medium		

Table 7: Mudflats and Sandflats Condition.

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Mudflats & sandflats not covered by seawater at low tide				
Component of habitat feature assessed	Indicative Assessment (*Favourable, unfavourable, unknown*)	Key evidence type used (*Monitoring data, reports or expert judgement*)	Level of agreement	Confidence in evidence	Component confidence level
Distribution & Extent (within site)	Unfavourable	Some monitoring data, expert judgement	High	Medium	Medium
Structure & function	Unfavourable	Expert judgement, WFD assessments	Low	Low	Low
Typical species	Favourable	Monitoring data, expert judgement & WFD assessments	High	Medium	Medium
Relevant activities (activities directly impacting condition of the feature on this site)			Development issues Water quality issues		
Overall Indicative Assessment			Overall Confidence Level		
Unfavourable			Medium		

Table 8: Saltmarsh Habitat Condition.

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)				
Component of habitat feature assessed	Indicative Assessment (*Favourable, unfavourable, unknown*)	Key evidence type used (*Monitoring data, reports or expert judgement*)	Level of agreement	Confidence in evidence	Component confidence level
Distribution & Extent (within site)	Unfavourable	Expert judgement (knowledge of historical modification to the estuaries), reports, expert judgement based on casework.	High	High	High
Structure & function	Unfavourable	Expert judgement (knowledge of historical modification to the estuaries), WFD assessments, Expert judgement based on casework.	High	High	High
Typical species	Unfavourable	Monitoring data, expert judgement	High	Medium	Medium
Relevant activities (activities directly impacting condition of the feature on this site)			Grazing Infrastructure development: Pont Briwet and Dwyryd Pylon Coastal defence and erosion control		
Overall Indicative Assessment			Overall Confidence Level		
Unfavourable			High		

4.8 Annex II Species – NRW Indicative Condition Report

4.8.1 The tables below are extracted from the PLAS SAC - Indicative site level feature condition assessments 2018, NRW Evidence Report No: 234. These tables describe the current status the Annex II features relevant to the project (Tables 11-13).

Table 9: Bottlenose Dolphin population condition.

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Bottlenose dolphin (Tursiops truncatus)				
Component of species feature assessed	**Indicative Assessment** (*Favourable, unfavourable, unknown*)	**Key evidence type used** (*monitoring data, reports or expert judgement*)	**Level of agreement**	**Confidence in evidence**	**Component confidence level**
Population (*e.g. size, structure, production, condition of species within site, contaminant burdens*)	Favourable	Monitoring data, report	Medium	Medium	Medium
Range (within site)	Favourable	Monitoring data, report	Medium	Medium	Medium
Supporting habitats					
Distribution & extent	Unknown	Expert judgement	Medium	Not applicable	Not applicable
Structure & function	Unknown	Expert judgement	Medium	Not applicable	Not applicable
Prey availability and quality	Unknown.	Expert judgement	Medium	Not applicable	Not applicable
Relevant activities (*activities directly impacting condition of the feature on this site*)			No activities identified as having a direct impact on feature condition.		
Overall Indicative Assessment			Overall Confidence Level		
Favourable			High		

4.8.2 Described in NRW PLAS SAC Regulation 33 Advice February 2009, Bottlenose dolphins are adapted to living in the marine environment and are adapted to the many challenging aspects of that environment. However, artificially introduced hazards and reductions in the natural quality and suitability of the bottlenose dolphin habitat in the SAC can occur through:

- The presence and persistence of artificial inert or toxic materials (e.g. plastics, synthetic fibres, hydrocarbons) causing entanglement, smothering or ill-health.

- Competition with human activities for space causing displacement, collision, noise/ visual disturbance and increasing density dependent pressure on sites and increased stress rendering animals susceptible to the effects of normally dormant endemic viral diseases.

- Contamination of prey.

4.8.3 The principle contactor will adopt the Gwynedd Marine Code regarding Bottlenose Dolphins, Porpoises & Seals in relation to project and distribute a copy of the code to the work force.

4.8.4 The pressure vectors on this species including hydrocarbons and entanglement will be addressed in Section 8 – Proposed Mitigation.

Table 10: Otter population condition (Feature overlaps with SSSI).

Date	May 2017				
Site name	Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC				
Site feature assessed	Otter (Lutra lutra)				
Component of species feature assessed	**Indicative Assessment** (*Favourable, unfavourable, unknown*)	**Key evidence type used** (*monitoring data, reports or expert judgement*)	**Level of agreement**	**Confidence in evidence**	**Component confidence level**
Population (*e.g. size, structure, production, condition of species within site, contaminant burdens*)	Favourable	Monitoring data, reports & expert judgement.	High	Medium	Medium
Range (within site)	Unknown	Expert judgement	High	Not applicable	Not applicable
Supporting habitats					
Distribution & extent	Unknown	Expert judgement	High	Low	Low
Structure & function	Unknown	Expert judgement	High	Not applicable	Not applicable
Prey availability and quality	Unknown.	Expert judgement	High	Low	Low
Relevant activities (*activities directly impacting condition of the feature on this site*)			No activities identified as having a direct impact on site condition.		
Overall Indicative Assessment			Overall Confidence Level		
Favourable			Medium		

4.8.5 Surveys indicate regular otter use of the Glaslyn/Dwyryd and Dyfi estuaries as well as signs of otters by the Mawddach estuary. Otters living on the coast must have access to freshwater streams and pools for drinking and washing. Otters need to wash in freshwater in order to maintain the insulating properties of their fur. The lack of available freshwater might explain the restricted distribution of otters living along the coast in some areas of the UK, however the SAC is well served with rivers and streams throughout its length.

4.8.6 Habitat essential for otters, i.e. well vegetated stream and river valleys, access to the shore, access to freshwater and secluded resting habitats are high throughout much of the site. The structural and functional integrity of this essential habitat is considered to be good.

4.8.7 Whilst good quality essential habitat is available within the SAC and adjacent area, the quality and suitability of this habitat can be reduced in a variety of ways, including:

- The presence and persistence of artificial inert materials (e.g. plastics, synthetic fibres, static fishing gear) leading to entanglement and smothering;
- A decrease in seclusion because of noise and visual disturbance as a result of increased human access, habitation and waterborne activities;
- The presence and persistence of toxic contaminants, including the risk of fur contamination from oil discharged into freshwater and marine environments;
- Availability and quality of prey.

5. NIRAS Fish Survey Data

5.1 Spawning areas and Nursey grounds

5.1.1 This section outlines data from the NIRAS Fish Ecology Survey. The survey assesses commercial and protected fish species. Although not Annex II species within the SAC designation, they are supported by the Annex I habitats. This section mirrors that within Barmouth Viaduct HRA EV200213.HRA.001.

5.2 Protected Species

5.2.1 The table below features extracts from the Fish Ecology Report. The descriptions are summarised by a high low probability of an individual species likelihood of proximity to the project.

Table 11: Comments on protected fish species from NIRAS report. Included likelihood of occurring within project footprint.

Species	Comments relating to proximity to project	Likelihood of Proximity to Project	
		High	Low
Common and sand goby,	Both the common goby and sand goby will likely be present in the vicinity of the Project site.	✓	
Allis and twaite shad	According to the JNCC (2018), there is no significant presence of allis and twaite shad occurring in the vicinity of the Project site.	✓	
Smelt,	This species is listed as UK BAP Priority Species and a species of principal importance for the purpose of conservation of biodiversity under the Natural Environment and Rural Communities Act (2006). Smelt are not commonly found in the Mawddach Estuary or local vicinity (JNCC, 2018).		✓
Sea lamprey	River, Brook and Sea lampreys are not commonly observed in the Project site (JNCC, 2018). However, the Teifi river on the Southern part of Cardigan Bay does support a large population of the river lamprey Lampetra fluviatilis (JNCC, 2018).	✓	
Common Skate	The North Wales coast is known to have ideal conditions for skates and rays and this includes the benthic habitat of the Project Site and common skate is recorded as present in the Sarnau of Cardigan Bay (CEFAS tech report no 147).	✓	
Angel Shark	Angel sharks prefer sandy habitats which are close to rocky reefs, as recorded within the Pen Llyn a'r Sarnau SAC. Further information on distribution of this species includes sightings concentrated around Harlech, in particular Shell Island (Pen Llyn a'r Sarnau Liaison Group, Meeting Minutes, 2017) located to the north of the Project site.		✓
Basking shark	Although Cardigan Bay is not a recognised hot spot for basking shark it is quite likely that they do frequent local coastal waters (although unlikely to occur within the estuary itself), if not feeding at the surface then transiting between favoured areas north (e.g. Isle of Man) and south (the Celtic Sea) (Scottish Natural Heritage Report No 908).		✓

5.2.2 Species indicated as high likelihood require further assessment. The table below illustrates the general spawning period of these species.

Table 12: Spawning periods (blue highlight) of fish species indicated as occurring within project vicinity.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sand Goby												
Allis shad												
Twaite shad												
Sea lamprey												
Common Skate												

5.2.3 From the table above it is evident that the vast majority of these species spawning period occurs outside of the project window. Works within the estuary itself would occur in July as indicated in the methodology above. While the blockades utilising vessels are later in the year and further less likely cause disturbance.

5.3 Migratory Species

Table 13: Comments on Migratory fish species from NIRAS report. Included likelihood of occurring within project footprint.

Species	Comments relating to proximity to project	Likelihood of Proximity to Project	
		High	Low
Salmon	Salmon concentrate on the mouth of the Mawddach Estuary during settled weather between October and the end of March, although the peak activity takes place between November and January, awaiting rising river levels to make their way upstream. This indicates that the poor catchments of freshwater tributaries	✓	
Sea trout	Trout fry densities have improved in the Mawddach estuary compared to previous spatial surveys undertaken in 2010. Several sites across the catchment had the highest densities on record during the NRW 2017 survey while other sites remained consistent with the historic data. Trout parr have also improved across the catchment and numbers are expected to increase in the coming years due to the improved fry densities.	✓	
European eel	European eels have been recorded in the Mawddach Estuary in the vicinity of the Project site in a 4-year programme to establish the status and stocks in England and Wales. Eel stocks in the Mawddach Estuary are thought to be still at or near to carrying capacity with male-dominated populations (Bark et al., 2007).	✓	

Table 14: Spawning periods (blue highlight) of fish species indicated as occurring within project vicinity.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salmon												
Sea trout												
European eel												

5.3.1 The migratory species above will be spawning during the Phase II blockade. However, at this stage the vast majority of works requiring estuary access will be completed, although the resting of the barge at high tide and some machine access will continue. The overall level of sediment disturbance will be reduced in comparison to the gabion/reno mattress works proposed for Phase I.

5.3.2 As the portion of the estuary that remains flowing during low tide will not be impeded upon at any stage, it is unlikely that these species will find their natural range reduced. Vessel traffic will occur during the works, however this will not be dissimilar to current water traffic around Barmouth docks and will only be undertaken during periods when the tide is high enough for access.

5.4 Transient (Vagrant) Species

Table 15: Comments on Transient fish species from NIRAS report. Included likelihood of occurring within project footprint.

Species	Comments relating to proximity to project	Likelihood of Proximity to Project	
		High	Low
Sunfish	This species feeds on jellyfish, plankton, brittle stars, molluscs and crustaceans. It is found in warm and temperate regions of the Pacific and Atlantic oceans (Froes & Pauly, 2011). Sunfish have been reported in the vicinity of the Project site about one mile off the coast situated between Harlech and Barmouth in Cardigan Bay (JNCC, 2018).	✓	
Pilotfish	There appears to be no accounts of it being recorded in the vicinity of the Project site. It may travel with sharks or other large marine animals or sometimes along with large ships (Froese & Pauly, 2011).		✓

5.4.1 Although it is possible Sunfish may be in the vicinity of the project, the proposed works methodologies are unlikely to impact the species feeding habits.

5.5 Spawning Areas and Nursery grounds

Table 16: Comments on Spawning Areas and Nursery Grounds from NIRAS report. Included likelihood of occurring within project footprint.

Species	Comments relating to proximity to project	Likelihood of Proximity to Project	
		High	Low
Anglerfish	Anglerfish spawning grounds are located outside Cardigan Bay and outside of the Project site. As such, no spawning ground maps for Anglerfish have been drawn. Nursery grounds on the other hand are ubiquitous located throughout Cardigan Bay, including the Project site and the Mawddach Estuary.		✓
Cod	Cod spawning grounds are located in Cardigan Bay and the Project site, including part of the Mawddach Estuary. Nursery grounds on the other hand are limited to Anglesey and about 75km west of Cardigan Bay in the Irish Sea. Therefore cod nursery grounds are not present in the vicinity of the Project site.		✓
Ling & Mackerel	Ling spawning grounds are limited to 25km west off the Pembrokeshire coast and not in the vicinity of the Project site. Likewise, Mackerel spawning grounds are located north of Cardigan Bay and not in the vicinity of the Project site. No Nursery grounds for either species have been identified close to Cardigan Bay and as such, nursery grounds for the species have not been drawn.		✓
Norwegian prawn,	Both the spawning and nursery grounds of Nephrops are located in the central Irish Sea to the north west of the Cardigan Bay and not in the vicinity of the Project site		✓
European Plaice	Plaice spawning grounds include most of the coastal eastern Irish Sea including Cardigan Bay, the Project site and part of the Mawddach Estuary. The main nursery grounds for juvenile plaice have been identified along the coastal waters of North Wales (Ellis et al., 2012) including the Project site, where the newly benthic-orientated juveniles spend between 1 and 3 years before migrating offshore into deeper water (Fox et al., 2007).	✓	
Sandeel	Sandeel spawning grounds are located in Anglesey and Cardigan Bay, including the Project site and most of the Mawddach Estuary. Nursery grounds on the other hand are limited to Anglesey and further west of Cardigan Bay, about 75km west into the Irish Sea. Sandeel nursery grounds are therefore not present in the vicinity of the Project site.		✓
Sole	Sole spawning grounds are located mainly in the shallow water of the eastern Irish Sea including Cardigan Bay (Symonds et al., 1995) and the project site, spreading as far as out as 50km from the Project site. Sole nursery grounds are not located within Cardigan Bay and are restricted to the north eastern Irish Sea (Liverpool Bay and the Fleetwood coasts). As such, sole nursery grounds are not located in close proximity to the Project site.	✓	

Species	Comments relating to proximity to project	Likelihood of Proximity to Project	
		High	Low
Sprat	Sprat spawning grounds are located about 25km from the Project site to the west of Cardigan Bay towards the central Irish Sea and North towards Anglesey but not in the vicinity of the Project site. Nursery grounds are not located in the vicinity of Cardigan Bay and as such, no nursery grounds maps have been drawn.		✓
Spotted Ray	Given the lack of data available, no spawning grounds maps have been drawn for spotted ray as the data is either not available or the spawning grounds are outside the Project area. Nursery grounds on the other hand are located throughout Cardigan Bay and Anglesey, including the Project site and the Mawddach Estuary.	✓	
Thornback	As such, no spawning data is available, and no spawning maps have been drawn for this species. With regards to the nursey grounds however, Cardigan Bay is considered an area of importance to juvenile thornback rays (CEFAS Technical Report No 147). Nursery grounds are recorded around Anglesey and Cardigan Bay, including the Project site and Mawddach Estuary.	✓	
Tope Shark	Tope shark nursery grounds are located in the south of Cardigan bay off the Pembrokeshire coast and north of the Project site off the north coast of the Llyn peninsula and the coast of Anglesey. Nursery grounds are not located in the vicinity of the Project site		✓
Whiting	Whiting nursery grounds spread as far as 75km offshore from the Project site and again include most of the eastern Irish Sea.	✓	

5.5.1 From table 16 above the assessment notes that European Plaice, Sole, Spotted Ray, Thornback and Whiting nursery and spawning encompasses areas in which the Viaduct resides. However, from the available information the habitat below the structure does not appear to be a directly essential area for these species listed below, but as a component of a much wider range.

5.5.2 The scale and duration of impact on the habitat below the structure is limited and relatively short in duration. The likelihood of substantial impact to the population dynamics of these species above is low when considering their continued presence in an otherwise busy estuary.

5.5.3 The mitigations in relation to pollution and bio security measures in the sections below will ensure that the project does not cause a reduction in the vitality of these fish species population.

5.6 Compound and Structure Location in relation to Designated site and Ecological base-value

5.6.1 Site 1 Morfa requires the most input to construct a viable compound (Figure 8 below). An Extended Phase I Habitat Survey was commissioned in March 2020 to inform the Principle Contractor of the necessary considerations during compound setup. Although the chosen location is not directly within the designated sites boundaries, it's proximity and specific habitat features merit further mitigation measures. This compound is being considered as part of this assessment due to its proximity to the estuary and because it provides access to the estuary.

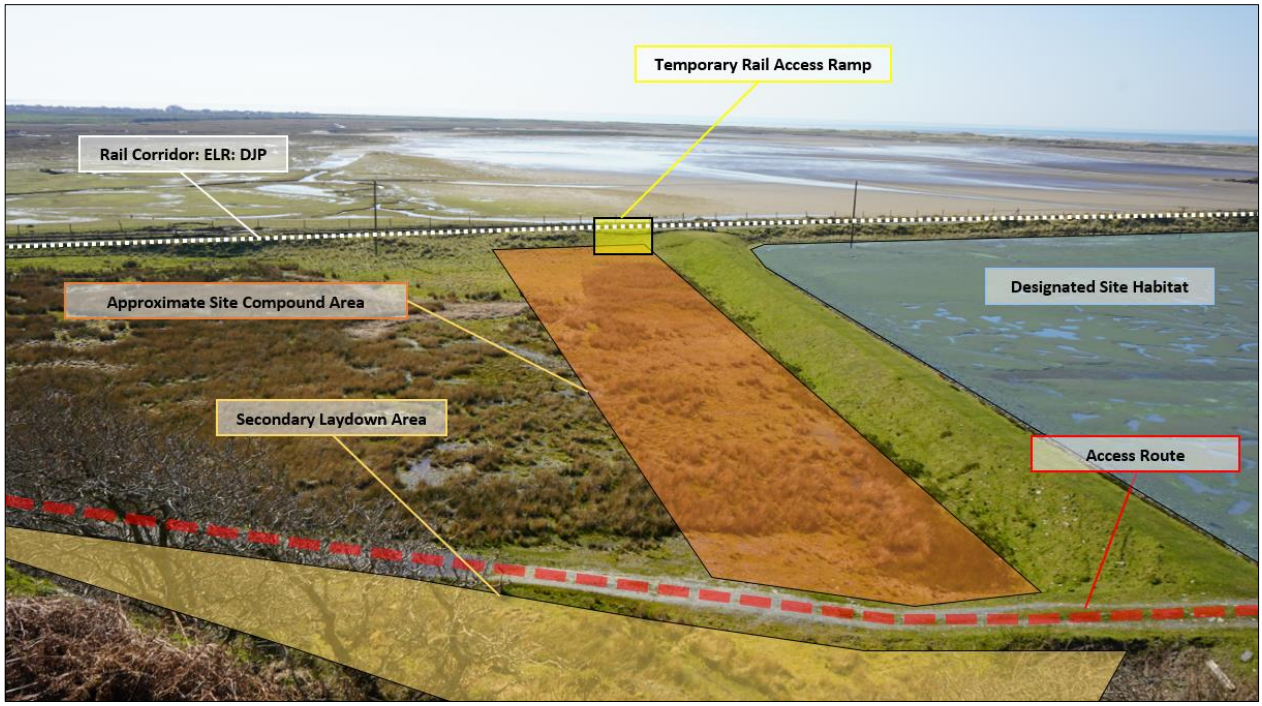

Figure 8: Photo of habitat with approx. compound overlay.

5.6.2 In proximity to the project an outlier badger sett was identified. The majority of activity is appearing within one of two dunes. The second dune closest to the Morfa Compound appears to be a smaller entrance, possibly related to smaller mammal species. A Welsh Government Disturbance & Exclusion license will be applied for to exclude the second dune (with the single entrance feature) from further habitation during the project.

5.6.3 An access ramp will be made between the dunes (SD7) and sea defence bund. This will follow the existing contour of the slope to prevent undermining the dune features. This ramp will remain for the duration of the project as with the rest of the formilised compound.

5.6.4 The second dune will be left in its current state as it is a significant distance away from projected compound and access to the outlier is not prevented by the proposed project footprint.

5.6.5 The Phase I habitat survey also allowed the positioning of required project assets to be measured against the current habitat features present at site (see figure 9)

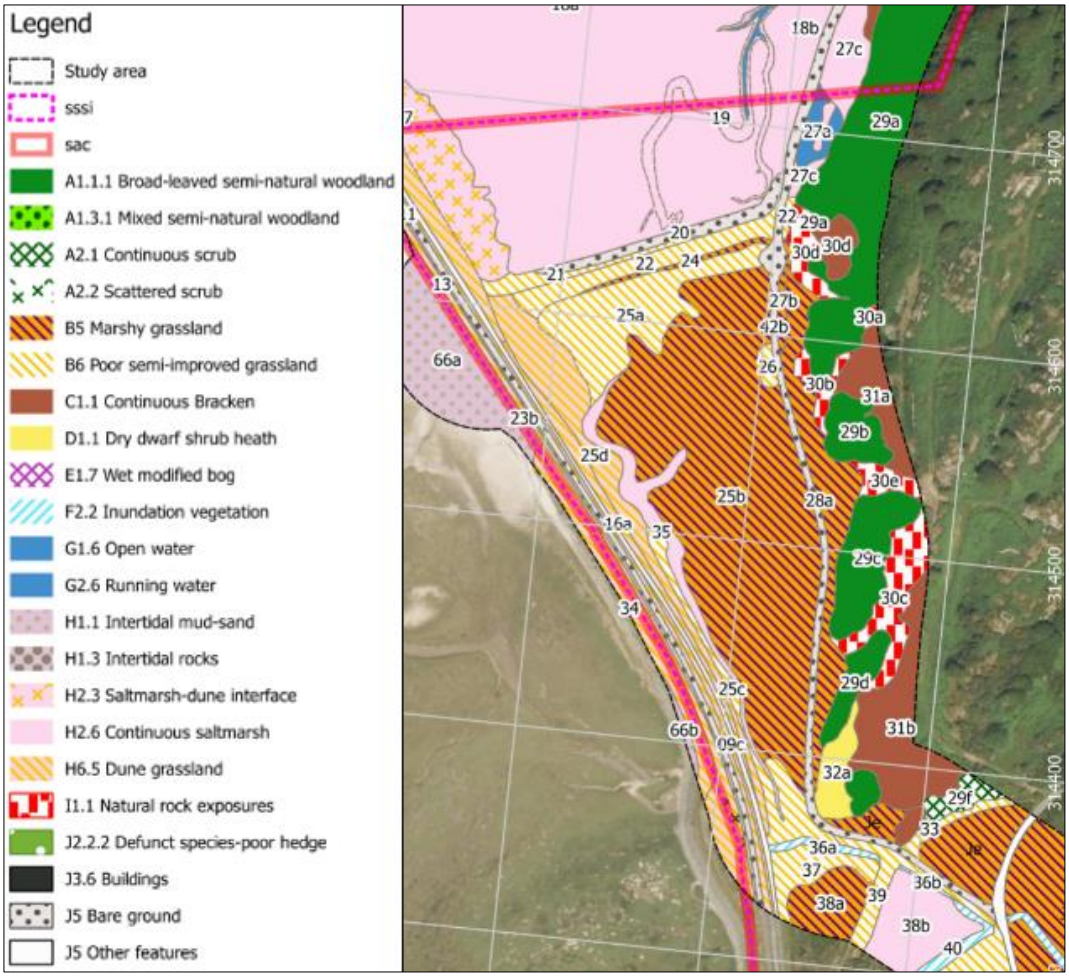

Figure 9: Phase I Map extract from 2020 survey.

5.7 Curent Condition of Waterbodies

5.7.1 Table 17 below records the condition of the Mawddach Estuary, in which the works will be undertaken and other waterbodies up and down stream of this, which have potential to be impacted by the proposed works. Data has been gained from the NRW Water Watch Wales Data Base and Interactive Mapping.

Table 17: Summary of the WFD status of the rivers / watercourses flowing into the Mawddach Estuary

Waterbody name, ID, Type, Management Catchment, River Basin District.	Hydro-morphological designation	Current overall status & objectives	Biological elements	Physico-chemical elements	Water body Protected Area Links
Mawddach (GB511006407100) Type: Transitional (Estuary) Man Catchment: Meirionnydd Transitional Coastal RBD: Western Wales Area Name: WA North	Not designated as heavily modified Morphology = Not High Hydrological Regime = Not High	Current overall status = Moderate; Objective = Good by 2021 Current ecological status = Good; Objective = Good by 2021 Current chemical status = Fail; Objective = Good by 2021	Fish = Not assessed Macroalgae = High Phytoplankton = Not assessed Opportunistic Macroalgae = High Invertebrates = Good Infaunal Quality Index = Good	Dissolved oxygen = High Dissolved Inorganic Nitrogen – Good Phosphate = Moderate Annex 8 Chemicals = High Copper = High Zinc = High Cadmium = High Brominated diphenylether (BDPE) Calc = Moderate Hexachlorobutadiene = High Hexachlorobenzene = high Mercury = High Fluoranthene = High Lead = High Nickel = High	Protected Area = Yes Bathing Waters = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No Shellfish Water = Yes
Cardigan Bay North (GB621009600000) Type: Coastal Man Catchment: Western Wales TraC RBD: Western Wales Area Name: WA North		Current overall status = Moderate; Objective = Good by 2021 Current ecological status = Good; Objective = Good by 2021 Current chemical status = Fail; Objective = Good by 2021	Fish = Not assessed Macroalgae = High Phytoplankton = High Rocky Shore Macroalgae= High Opportunistic Macroalgae = High Invertebrates = Good Infaunal Quality Index = Good Imposex = Good	Dissolved oxygen = High Dissolved Inorganic Nitrogen – Good Phosphate = Moderate Annex 8 Chemicals = High Arsenic = High Copper = High Iron = High Zinc = High Cadmium = High Brominated diphenylether (BDPE) Calc = Moderate Hexachlorobutadiene = High Hexachlorobenzene = high Mercury = High Fluoranthene = High Lead = High Nickel = High	Protected Area = Yes Bathing Waters = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No Shellfish Water = Yes
Mawdach Lower (GB110064048710) Type: River Man Catchment: Meirionnydd	Not designated as heavily modified.	Current overall status = Good; Objective = Good by 2021 Current ecological status = Good;	Macrophytes and Phytobenthos = Good Macrophytes Sub Element = Good	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen – Good Ammonia (Phys-Chem) = High	Protected Area = Yes Bathing Waters = No

Waterbody name, ID, Type, Management Catchment, River Basin District.	Hydro-morphological designation	Current overall status & objectives	Biological elements	Physico-chemical elements	Water body Protected Area Links
RBD: Western Wales Area Name: WA North	Morphology = Not High Hydrological Regime = Not High	Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Phytobenthos Sub Element = Good Fish = Not assessed Macroalgae = High Phytoplankton = Not assessed Opportunistic Macroalgae = High Invertebrates = High Infaunal Quality Index = Good	BOD = High Phosphate = High Annex 8 Chemicals = High Arsenic = High Copper = High Iron = High Zinc = High Manganese = High Benzo (b) and (k) fluoranthene = High Benzo (ghi) perelyene and indeno (123-cd) pyrene = High Cadmium = High Fluoranthene = High Lead = High Nickel = High Aldrin, Dieldrin, Endrin & Isodrin = High para - para DDT = High Temp = High	Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No Shellfish Water = No
Wnion Lower (GB110064048800) Type: River Man Catchment: Meirionnydd RBD: Western Wales Area Name: WA North	Not designated as heavily modified	Current overall status = Good; Objective = Good by 2021 Current ecological status = Good; Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Special Area of Conservation Fish = Good Phytoplankton = Moderate Invertebrates = High	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen – Good Ammonia (Phys-Chem) = High Phosphate = High Annex 8 Chemicals = High Arsenic = High Copper = High Iron = High Zinc = High Manganese = High Benzo (b) and (k) fluoranthene = High Benzo (ghi) perelyene and indeno (123-cd) pyrene = High Cadmium = High Fluoranthene = High Lead = High Nickel = High Aldrin, Dieldrin, Endrin & Isodrin = High para - para DDT = High Temp = High	Protected Area = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No

Waterbody name, ID, Type, Management Catchment, River Basin District.	Hydro-morphological designation	Current overall status & objectives	Biological elements	Physico-chemical elements	Water body Protected Area Links
Gwynant (Mawddach Estuary) (GB110064048660) Type: River Man Catchment: Meirionnydd RBD: Western Wales Area Name: WA North	Not designated as heavily modified	Current overall status = Good; Objective = Good by 2021 Current ecological status = Good; Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Special Area of Conservation Fish = Not assessed	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen – Good Ammonia (Phys-Chem) = High Phosphate = High Annex 8 Chemicals = Not assessed Temp = High	Protected Area = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No
Cwn-Mynach (GB110064048820) Type: River Man Catchment: Meirionnydd RBD: Western Wales Area Name: WA North	Not designated as heavily modified	Current overall status = Good; Objective = Good by 2021 Current ecological status = Good; Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Special Area of Conservation Fish = Not assessed	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen = High Ammonia (Phys-Chem) = High Phosphate = High Temp = High	Protected Area = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No
Cwm-Llechen (GB110064048810) Type: River Man Catchment: Meirionnydd RBD: Western Wales Area Name: WA North	Not designated as heavily modified Morphology = Good	Current overall status = Good; Objective = Good by 2021 Current ecological status = Moderate; Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Special Area of Conservation Fish = Not assessed	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen = High Ammonia (Phys-Chem) = High Phosphate = High Temp = High	Protected Area = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No

Waterbody name, ID, Type, Management Catchment, River Basin District.	Hydro-morphological designation	Current overall status & objectives	Biological elements	Physico-chemical elements	Water body Protected Area Links
Dwynant (GB110064048700) Type: River Man Catchment: Meirionnydd RBD: Western Wales Area Name: WA North	Not designated as heavily modified	Current overall status = Good; Objective = Good by 2021 Current ecological status = Moderate; Objective = Good by 2021 Current chemical status = Good; Objective = Good by 2021	Special Area of Conservation Fish = Not assessed	Dissolved oxygen = High pH = High Dissolved Inorganic Nitrogen = High Ammonia (Phys-Chem) = High Phosphate = High Temp = High	Protected Area = Yes Special Protection Area = No Drinking Water Protected Area = No Special Area of Conservation = Yes Nitrate Vulnerable Zone = No
Meirionnydd (GB41002G203200) Type: Groundwater Man Catchment: Meirionnydd Ground Water RBD: Western Wales Area Name: WA North		Current overall status = Poor; Current Quantitative status = Good Current chemical status = Poor.			Protected Area = Yes Special Protection Area = Yes Drinking Water Protected Area = Yes Special Area of Conservation = Yes Nitrate Vulnerable Zone = No

6. Refurbishment Project Methodology

6.1 Viaduct Refurbishment – Access to Structure Methodology

6.1.1 Several methods of access to the rail structure have been discussed between NRW SSSI Assent and Principle Contractor Project Team members.

6.1.2 Utilising the risk hierarchy, all other options were eliminated in favour of using the existing track running along the edges of the cliffs to the North East of the Morfa site before joining the shale embankment between the saltmarsh and the beach. OS Mapping indicates this is the remains of the old tram way along the Southern Shore of the Afon Mawddach (see figure 11).

6.1.3 The ideal outcome is that little to no additional stone material will be required to modify the surface of the shale bank. Low ground pressure track machines (likely 360 excavator supported by tracked dumper vehicle) will follow the route defined within this plan.

6.1.4 Much of the existing road leading up to the shale bank is of modern design with a geotextile membrane present in its construction (appears to be Terram 1000 from observation). Therefore, it is likely this section of road/track is robust enough to carry the limited traffic proposed to undertake the refurbishment.

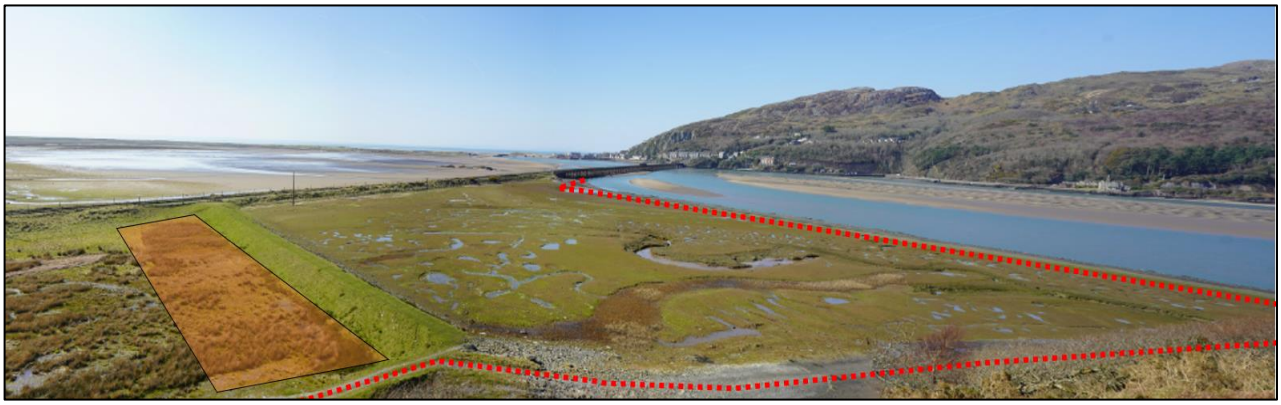

Figure 10: Access route to estuary.

6.1.5 There is a low spot within the shale bank which allows water from the estuary to enter the saltmarsh during high tides. The bed / invert level of this will be recorded prior to the commencement of works, to ensure this level is retained for the duration of the contract. This drainage feature (highlighted in figure 12b next page) will not be modified as a preferred option. Although this is not a lagoon feature it is integral to the gradual drainage of the salt marsh habitat.

6.1.6 Consequently, if movement of vehicles begins to degrade it's function as a drainage route, a temporary crossing will be installed using locally sourced shale and drainage piping or channels installed to the same level as the measured bed / invert level, to maintain the current flow of water while allowing continued vehicle movement outside of the salt marsh habitat.

6.1.7 Where possible, the existing shale present along the bank would be used to create any necessary modification to limit or even eliminate the need for importing new material. If any materials are imported, they will be laid on a geotextile separation layer to aid their removal on the completion of the works.

Figure 11: Caption in descending order A, B, C of access route.

6.2 Viaduct Refurbishment – Referbishment Methodology

6.2.1 Phase I of the project is set to occur over 6 months and Phase II occurring over 7 months in total. However, this represents the entire project durations, activities within the estuary itself will be over a shorter period, as January 2021 involves de-mobilisation.

6.2.2 The spacing between the viaduct piers close to the solid sea defence at the start of the timber bridge (Morfa south) is wide enough to allow plant/vehicles to move beneath the structure and access both sides of the Viaduct (see figure 13) without the need to add an additional access route along the salt marsh habitat to the west of the rail.

Figure 12: Vehicle Route either side of the structure.

6.2.3 During Phase I in the initial stages, there is a need to prepare for the replacement of the vertical pile sections of the viaduct piers (vertical timber columns) during the rail blockades. Below the Viaduct structure are existing Reno stone mattresses (stone filled gabion mattresses preventing scour below the structure and protecting the buried section of timber from being exposed (Figure 14, next page illustrates the timber structure supporting components).

6.2.4 There are concrete shrouds around the base of the timber piers, up to high tide level, to prevent shipworm burrowing into the viaduct piles of the viaduct piers.

6.2.5 The existing concrete shrouds around the piles will be broken away to expose the protected timber. The material arising from this will be collected and removed from the estuary.

6.2.6 It is proposed to excavate around the base of the viaduct piers prior to the rail possessions and place 1m x 1m gabion baskets into the excavations. These will be lifted out during the blockade to provide access to the base of the pier piles for them to be cut below the estuary bed level and new timbers spliced onto the existing piles.

6.2.7 Following the removal of the concrete shrouds, operatives will cut into the existing reno mattress 1m either side of the bases of the piers and excavate stone material from the mattresses. Only the portion of reno mattress around the specific piles requiring replacement will be modified. Excavation supports may be required for the excavations but as the excavations will be less than 1m deep, these will not be substantial.

6.2.8 In the cavity created by the excavation new gabion baskets will be installed in their place and left in situ. Reno mattress stone material will be reused as much as possible to reduce the requirement of new stone for the gabion baskets.

6.2.9 As the piles cannot be removed while the railway is in operation, the final stage (Step 3 figure 15, next page) will occur during the rail blockades in Phase I & II when it will be safe to remove these supports.

6.2.10 The replacement timber will be Greenheart hardwood which is naturally resistant to shipworm attack and degradation. Thus, it does not require intensive chemical protection to be used in a marine environment.

Figure 13: Illustration of individual timber structure supporting components.

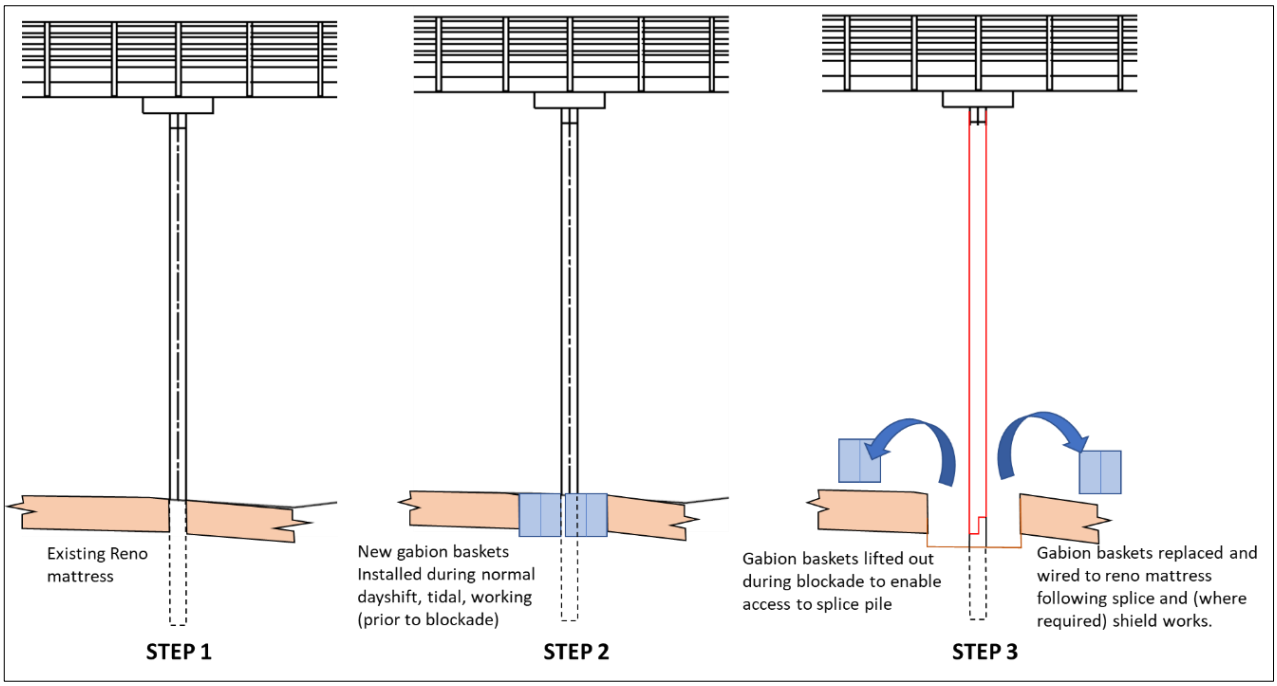

Figure 14: Stages of timber pile replacement process.

6.2.11 Once replaced, the new gabion baskets will be tied into the Reno mattress as a final securing measure.

6.2.12 Currently the design is being reviewed with two protection options proposed for the base of the viaduct piers; new concrete shrouds or raised gabion around the exposed section of timber above bed level.

6.2.13 As the Greenheart is naturally resistant it may not be necessary to install a new shroud and this option is currently being considered by Network Rail.

6.2.14 The use of coffer dams is not envisaged, within the estuary as excavations will not be deeper than 1m. However temporary frames to mould rapid drying marine concrete during low tide conditions is the planned methodology, should new concrete shrouds be required.

6.2.15 The works will be undertaken during low tide conditions and will take place predominantly in daytime, however there may be early morning shifts or shifts into the evenings depending on tidal variations.

6.2.16 Additional preparation works include the replacement of crosshead supports (see figure 16, next page) of the timber frame of the piers. This process will also be largely undertaken during low tide conditions.

6.2.17 Scaffolding will be erected on the structure, either from the estuary bed, attached to the viaduct or potentially a cantilever design from the viaduct. The main supports of the design will rely on the existing rail structure and will not require the formalisation of new supporting foundations to allow for scaffolding to be erected.

6.2.18 A jack up barge will not be required for the project as this need has been eliminated through novel design approaches, including upper structure lifts using a trestle propping method (essentially using the rail either side of an individual section as supports to lift the centre and access a bridge feature requiring replacement).

Figure 15: Cross head replacement process, supported by RRV & Barge.

6.2.19 During Phase II further preparation works, will be undertaken, which are similar to Phase I with works being undertaken during low tide conditions. Following all preparation works, a 90day rail blockade is to be initiated to undertake the remaining works. This will consist of removal of the viaduct deck to replace the upper horizontal supports above the crosshead and piles that support the rail and public footpath.

6.2.20 To undertake these works Road Rail Vehicles (RRV's) will work from the rail corridor to replace the spans, two separate crane teams will work from the centre away from each other (see figure 17 below).

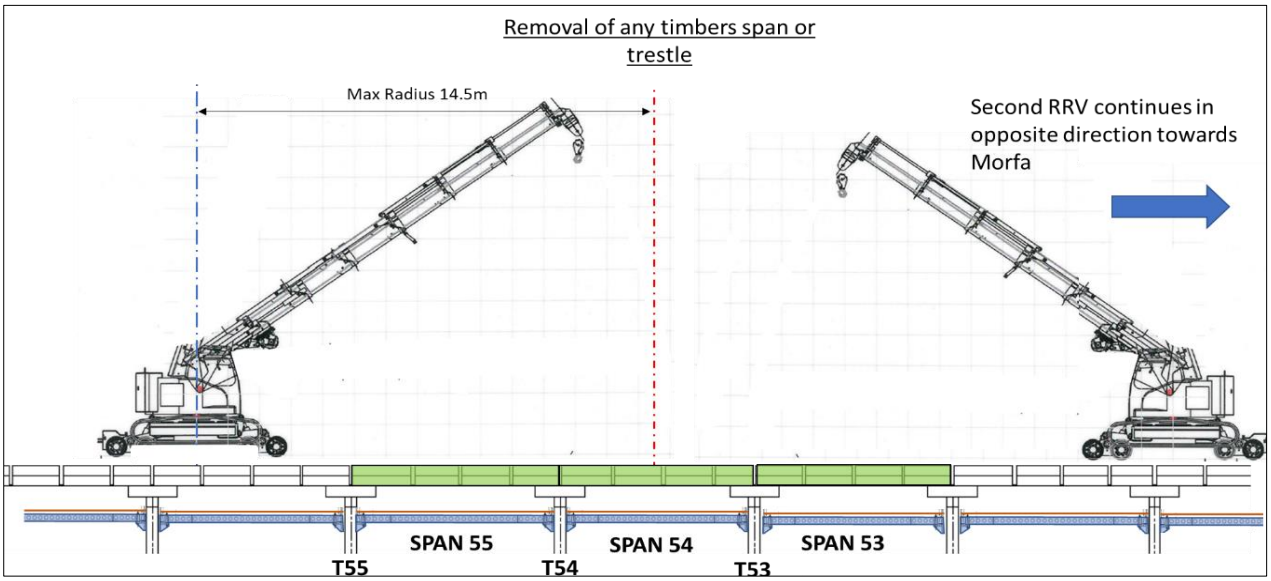

Figure 16: RRV units working away from each other.

6.2.21 A small barge launched from Barmouth Harbour will carry replacement timber will be required to deliver some of the new timber and supplies during works based from the track during high tide conditions within rail blockades. The majority of water bourn vessel use will occur during the 2020 16day blockade.

6.2.22 Following completion, site assets will be removed, any modifications within the designated site will be put back into its original state (primarily if additional material is required along the shale access route, this will be removed and the shale bank restored to its original profile, as surveyed prior to the commencement of works).

7. Water Framework Directive assessment: scoping for activities in estuarine and coastal waters

7.1.1 Consider the potential risks of your activity to each of these receptors: hydromorphology, biology (habitats and fish), water quality and protected areas. Also consider invasive non-native species (INNS).

7.2 Section 1: Hydromorphology

7.2.1 The first stage is to consider if there is hydromorphology at risk from your activity.

Table 18: Summary table to find out the hydromorphology status of the water body, if it is classed as heavily modified and for what use.

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	During construction, the existing concrete shrouds around the base of the viaduct piers will be broken out. There will then be limited excavation around the base of the piers predominantly within the existing reno mattresses to enable the installation of gabion baskets around the base of the piers. During the blockade of the rail, these will be removed and the new piers will be spliced onto the old ones. The gabion baskets will then be replaced to tie into the existing reno mattresses at the existing bed level. Works will be small scale, short duration with one or two piers being worked on at the same time. This will not have a significant impact on the hydromorphology of the estuary. Elements of the structure will be replaced on a like for like basis and hence, the completed works will not modify the current status of the estuary. Long term, the project will not present any change in the hydromorphological status of the estuary.
Could significantly impact the hydromorphology of any water body	Requires impact assessment	Impact assessment not required	Please see above - No impacts on any other water bodies.
Is in a water body that is heavily modified for the same use as your activity	Requires impact assessment	Impact assessment not required	The estuary is heavily modified by the presence of the viaduct, but the works do not make this situation any better or any worse as elements of the viaduct will be replaced like for like. The viaduct has been in situ for over a century. Current hydromorphology has become localised around the structure.

7.3 Section 2: Biology, Habitat & Fish

7.3.1 The second stage is to consider if habitats, Biology and Fish Species are at risk from your activity.

Table 19: Water body summary table and Magic maps, or other sources of information if available, to find the location and size of these habitats.

Higher sensitivity habitats [2]	**Lower sensitivity habitats [3]**
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	

[2] Higher sensitivity habitats have a low resistance to, and recovery rate, from human pressures.

[3] Lower sensitivity habitats have a medium to high resistance to, and recovery rate from, human pressures.

Table 20: Biology.

Consider if the footprint[4] 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	The total deck area of the section of viaduct to be worked on is 0.5km2 but the area of the works within the estuary is significantly smaller.
1% or more of the water body's area			The estuary covers an area of approximately 780ha. The section of the viaduct in question covers an area of 5,000m2 i.e. 0.5ha. The footprint of the works is therefore less than 1% of the estuaries area.
Within 500m of any higher sensitivity habitat			Works will be undertaken within the Afon Mawddach SSSI and Lleyn Peninsula and the Sarnau (SAC). Impacts from the works will be temporary as sections of the viaduct structure are being replaced on a like for like basis. The impact of the works on the SSSI and SAC are considered in the sections below.

Consider if the footprint[4] of your activity is:	Yes	No	Biology habitats risk issue(s)
1% or more of any lower sensitivity habitat			The construction compounds will be located on lower sensitivity land adjacent to the estuary but not within the tidal reach of the estuary or within the SSSI / SAC. The impact of the construction of these has been considered as part of the Habitat Regulations Assessment for the scheme.

[4] *Note that a footprint may also be a temperature or sediment plume. For dredging activity, a footprint is 1.5 times the dredge area.*

Table 21: Potential fish species at risk from your activity, but only if your activity is in an estuary or could affect fish in or entering an estuary.

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	Please refer to Section 5 – NIRAS Fish Survey Data
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	Please refer to Section 5 – NIRAS Fish Survey Data
Could cause entrainment or impingement of fish	Requires impact assessment	Impact assessment not required	No identified impacts.

7.3.2 Please refer recorded findings for biology habitats and fish in previous sections.

7.4 Section 3: Water quality

7.4.1 Stage 3 - Consider if water quality is at risk from your activity.

Table 22: Water body summary table to find information on phytoplankton status and harmful algae.

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	The removal of sections of the existing reno (gabion) mattresses, which prevent scour around the piers, is likely to release sand and sediment trapped within the stone of the mattress. Works will be undertaken at low tide and hence these will not be immediately released into the estuary but there is some potential for incoming tides to wash out small volumes of mobilised sediment. To quantify this, it is likely that works will be undertaken on a maximum of two piers per tidal cycle using two teams of operatives. The footprint of each work site will be approximately 16m^2. Construction plant will be used within the estuary and hence there is a heightened risk of hydrocarbon release due to leaks of fuels and oils.
Is in a water body with a phytoplankton status of moderate, poor or bad	Requires impact assessment	Impact assessment not required	**N/A**
Is in a water body with a history of harmful algae	Requires impact assessment	Impact assessment not required	**N/A**

Table 23: Assessing whether water quality is at risk from your activity through the use, release or disturbance of chemicals.

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	Replacement timber sections are untreated greenheart timber. Concrete used for the construction of the new shrouds around the viaduct piers will be a marine approved quick setting grout. No impact anticipated from activities.
It disturbs sediment with contaminants above Cefas Action Level 1	Requires impact assessment	Impact assessment not required	There are no indicators that sands within the estuary contain contaminants above Cefas Action Level 1. Excavation with the estuarine sands will be limited to 2.5m x 2.5m excavations around the piers to enable the new timbers to be jointed to the old wooden piles just below the existing bed level. Excavation will be undertaken at low tide and excavations will be capped with gabion baskets / reno mattresses, further limiting the availability of sediments to disturbance and mobilisation by the incoming tide.

Table 24: Assessing whether project falls within mixing zone.

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	There will be no discharge pipeline or outfall used as part of the scheme. There is potential for hydrocarbons to be released into the estuary, due to leaks from plant and vehicles. Suitable mitigation to be implemented to limit risk and impacts due to this.

[5] Carry out your impact assessment using the Environment Agency's surface water pollution risk assessment guidance, part of Environmental Permitting Regulations guidance.

7.5 Section 4: WFD protected areas

7.5.1 Stage 4 is to consider if WFD protected areas are at risk from your activity. These include:

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

Table 25: Location of protected areas in your water body (and adjacent water bodies) within 2km of your activity.

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2km of any WFD protected area[6]	Requires impact assessment	Impact assessment not required	The works will be undertaken within the Lleyn Peninsula and the Sarnau (SAC) and access will be required through the Afon Mawddach SSSI. This is considered within the following sections and also in the Habitat Regulations Assessment for the scheme. There are two intertidal reefs that are believed to be below the viaduct structure which will likely be impacted by the refurbishment works. It is noted within the data that these features are partially artificial (formed by the presence of the structure). It is likely that following works the continued presence of the structure will eventually yield a new reef habitat. Although the impact on these specific features may not be avoided. The overall impact on the SAC reef abundance is likely to be below -0.1% and therefore would not compromise the SAC's or SSSI's current conservation status.

[6] Note that a regulator can extend the 2km boundary if your activity has an especially high environmental risk.

7.6 Section 5: Invasive non-native species (INNS)

7.6.1 Stage 5 is to consider if there is a risk your activity could introduce or spread INNS.

7.6.2 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.

Table 26: Risk from INNS

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 been identified on site. Further searches for INNS will be undertaken as works progress at the site. Potential for the presence of INNS will be included within the site induction and method statement specific toolbox talks. This will include marine species as well as common plant species.

7.7 Summary of WFD Pre-Assessment findings

Table 27: Summary of Pre-Assessment Stage Findings.

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Minor short term risk during construction.	Mitigation to be out in place to minimise impacts from reno mattress and excavation works in the estuary.
Biology: habitats	Minor short term impacts on marine habitats during construction.	Mitigation to be put in place.
Biology: fish	Potential for impacts on migratory fish.	Mitigation to be put in place.
Water quality	Potential for short term impact during construction.	Potential for release of sediment due to reno mattress works and accidental release of hydrocarbons.
Protected areas	Works will be undertaken within the Afon Mawddach SSSI and Lleyn Peninsula and the Sarnau (SAC)	Working procedures and mitigation to be put in place to minimise potential for sediment release and hydrocarbon release.
Invasive non-native species	None identified.	Precautionary approach to be adopted.

7.7.1 The WFD guidance stipulates if a pre-assessment has not identified any receptors at risk during scoping, you don't need to continue to the impact assessment stage and your WFD assessment is complete.

7.7.2 However, if the pre-assessment identifies one or more receptors at risk during scoping, you should continue to the impact assessment stage.

Table 28: Water Framework Directive (WFD) Assessment for the Meirionnydd groundwater waterbody

WFD elements	**Assessment**
Chemical status	Temporary impacts during construction Excavation during construction will be undertaken for the splicing of the viaduct pier uprights onto the existing wooden piles below the estuary bed level. These excavations will not be deeper than 1m. Excavation may also be required within the compound area to level sections of ground. This excavation will be shallow with no interface with the groundwater table. Excavation as part of the works will not impact on groundwater at the site. Permanent effects during operation No predicted impacts from the operation of the rail structure as it is not proposed to replace any of the viaduct pier vertical uprights as part of these works. If significant decay is found in any of the viaduct piers, below the bed level of the estuary, the design will be reviewed and potential impacts o groundwater will be considered as part of this. Assessment outcome No adverse effects on the chemical status of the groundwater body have been identified and therefore this is scoped out of further assessment.
Quantitative status	Temporary impacts during construction No interaction with groundwater during construction. Permanent effects during operation No predicted impacts from the operation of the rail structure. Assessment outcome Effects to the quantitative status of the groundwater body have been scoped out of further assessment.

8. Proposed Project Mitigation

8.1 Construction Phase Mitigation

8.1.1 In Table 29 below, measures have been set out detailing mitigation to be implemented to minimise the potential project impacts.

Table 29: Proposed Mitigation Matrix

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
Estuarine habitat - Loss of habitat from project activities.	Works will be undertaken on one to two of the viaduct piers within the estuary at any one time. Works will consist of removal of a 2.5m – 3m section of the existing reno mattresses around the base of the wooden uprights of the viaduct piers. Holes will then be excavated to accept 1m x 1m gabion baskets around the base of the timber uprights. These will be lowered into place and the reno mattresses tied back into them. This work will be done with the railway in operation. During the line possession (blockade), the gabions will be removed to allow the damaged / degraded vertical uprights of the piers to be cut and new sections of timber spliced in. Overall, there will be a short-term impact to the estuarine habitat during the entire project. However, the scale of the impact when compared to the overall abundance of habitat within the SAC is small. This is further detailed within EV200213.HRA.001. The NIRAS intertidal survey suggests that habitat associated within the estuary will re-established readily. Key mitigation will be: Plant/machinery will not deviate from the designated routes at any time. Personnel will walk along the available public footpath or access route. No walking over the saltmarsh is permitted. Excavation sizes in the estuary will be minimised. Rock from the existing reno mattresses will be reused to minimise the requirement to import stone into the estuary. Retain existing reno mattresses.	Negligible likelihood of significant impacts.
Salt marshes (also part of estuarine habitat) - Loss of habitat from project activities.	No loss of habitat is projected to occur as all site access takes place along the existing road surface and shale bar along the estuary edge. No vehicle or pedestrian access into the saltmarsh SSSI. This requirement is to be briefed as part of the site induction and as part of method statements for works within the estuary.	Negligible likelihood of impacts.
Reefs - Loss of habitat from project activities.	The intertidal reefs referenced above that are believed to be below the structure will likely be impacted by the refurbishment works. It is noted within the data that these features are partially artificial (formed by the presence of the structure). It is likely that following works the continued presence of the structure will eventually yield a new reef habitat. Although the impact on these specific ID features referenced in EV200213.HRA.001 may not be avoided. The overall impact on the SAC reef abundance is likely to be below -0.1% and therefore would not compromise the SAC's or SSSI's current conservation status. Alternative positions of plant machines will be attempted prior to movement over the two possible reef features directly below the structure.	Negligible likelihood of impacts.

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
Mudflats and sandflats not covered by seawater at low tide – muddy gullies in the Mawddach Estuary - Loss of habitat from project activities.	Temporary impact to the habitats directly below and adjacent to the base of the structure will be temporary. NIRAS report suggest that mobile habitat will be regenerated readily, with re-establishment completed over 1-2 years following completion of project.	Negligible likelihood of impacts.
Contamination of the estuary from spillage of hydrocarbons during refuelling of plant and equipment or due to equipment failure.	Plant/Machinery will only operate in low tide conditions and will be removed from the estuary ahead of the rising tide. Provision will be made to remove broken down plant / vehicles or plant and vehicles which become bogged down. No refuelling of plant machinery or equipment will occur within the estuary habitat. All items of static plant will be paced within a plant nappy when in use or being stored. Plant will be checked for defects and leaks prior to the start of each shift. Bulk fuels will be stored in a bowser with secondary containment. This will be located in the site compound. Within the compound, a refuelling procedure will be implemented, whereby plant nappies will be placed beneath fuelling apertures during fuelling and refuelling will only be undertaken by designated, trained individuals using equipment specifically designed for that purpose. Network Rail have a spillage plan and specialised contractor in place to respond to and clean up spills. The Contractor will develop and implement an Emergency Awareness and Response Plan. This will describe how spills will be contained and cleaned up. The emergency plan will appoint an Incident Coordinator, define roles and responsibilities during an incident, detail response procedures and contain an inventory of response equipment to be maintained on site. Plant will also be available to remove contaminated ballast from site if required. All machinery entering the estuary will undergo regular checks and only use approved biodegradable oils. If oil leaks or damage to hydraulic hoses is noted, plant and machinery will be removed from the site and isolated within the site compound with containment measures beneath the leak, until it has been repaired and signed off by a competent fitter. The contractor will develop and emergency response plan in the event a machine becomes standard in the estuary from mechanical failure. Equipment will be available to syphon the fuel from the disabled machine in order to reduce the potential release of hydrocarbons into the estuary.	Negligible likelihood of impacts with mitigation in place.
Contamination of the estuary from release of concrete.	Works will only occur during low tide conditions. Concrete used will be a rapid drying marine standard which will have cured by the time the tide returns to the working area. No concrete / cementitious materials will be stored in areas within the tidal range of the estuary or in areas liable to flooding.	Negligible likelihood of impacts with mitigation in place.

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
Aggregations of non-breeding birds such as Red Shank & Snipe Noise disturbance / Visual Disturbance / Habitat Destruction.	Project activities will create a source of light and noise over 6-10 hours during the day. Times will vary due to the variation in the tide. As working hours are not continuous there will be periods were birds are not disturbed by site activities. However, it is likely that local bird populations are habituated to a level of disturbance from human activities, due to large numbers of pedestrians walking across the viaduct and trains crossing the viaduct. The Saltmarsh habitat adjacent to the access route/compound is heavily grazed and thus does not provide an abundance of nesting locations. Consequently, the project is unlikely to impact these species nesting sites.	Negligible likelihood of impacts with mitigation in place.
Individual wintering birds - Noise disturbance / Visual Disturbance / Habitat Destruction.	Works between Phase I and II will leave a period between 01/12/2020 to 01/06/2021 where no project activities will occur. Final completion is set for 01/2021. This would represent the only time works occur within winter. It is unlikely that these works will have a long term impact on overwinter birds present within the SSSI area.	Impact Not Likely to be Significant
Potential Bat species - Noise disturbance / Visual Disturbance / Habitat Destruction.	No trees require removal for the project to take place. Site lighting will be limited to lighting of safety critical areas and task lighting Other lighting will be PIR activated and will hence operate for short durations only. Task lighting will be low level flat glass LED luminairs and will be focused onto the task area, with minimal light spill. The project footprint occurs a significant distance away from the defined bat Sites.	Impact Not Likely to be Significant, with appropriate mitigation.
Otter - Noise disturbance / Visual Disturbance / Habitat Destruction.	Toolbox Talks will inform site personnel on identifying the Annex II Species. No otter holts have been noted to date within proximity to the structure, access route or Morfa Compound area. The project does not represent a hard boundary preventing access to the wider estuary by this species. Habitat impact is limited, however there may be a temporary impact to prey species disturbed by ongoing works. It is not anticipated that these works will have an impact on the population. Additionally, no equipment or excavation will be left in such a manner that during high tide an animal could become snared and trapped within the working area. Should an Otter be encountered during works, personnel will temporarily stand down until the animal has vacated the immediate area under its own volition. The contractor will abide by the Gwynedd Marine Code of Conduct. Salmon, which are a prey of Otter will not be prevented from travelling up the estuary during the project. Although the will be an elevated human presence around the structure, it is unlikely that this will present an impassable barrier to salmon migrating to spawn. Directional lighting measures as with those proposed for bat species will be implemented for Otter population to limit disturbance.	Impact Not Likely to be Significant, with appropriate mitigation

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
	24hr working is projected to be limited to only the 16day rail blockade in 2020. Night shifts will generally be limited to a Saturday night. These works will only take place from the structure itself and will not feature machine access to the estuary during low tide.	
Bottle Nose Dolphin - Noise disturbance / Visual Disturbance / Habitat Destruction.	See above. It is likely that this species is habituated to a level of marine traffic along this section of estuary as a result of the nearby fishing dock. Additionally, as the bridge is an active railway and pedestrian route, consistent levels of vibrations, noise and visual disturbances are already emitted from this area. There is potential for disturbance from the use of barges, particularly at night. These activities will be occasional however and short in duration. These sorts of activities have been shown to be of interest to animals but be perceived as non-threatening. The principle contactor will adopt the Gwynedd Marine Code regarding Bottlenose Dolphins, Porpoises & Seals in relation to project and distribute a copy of the code to the work force	Impact Not Likely to be Significant, with appropriate mitigation
Grey Seal - Noise disturbance / Visual Disturbance / Habitat Destruction.	See above.	Impact Not Likely to be Significant, with appropriate mitigation
Fish Assemblage – Pollution and water quality impacts.	Pollution control and Biosecurity measures implemented as described above will minimise water quality impacts on fish species.	Impact Not Likely to be Significant, with appropriate mitigation
Fish Assemblage - Noise disturbance / Visual Disturbance / Habitat Destruction.	The majority of the works will be undertaken outside of the fish spawning season for migratory fish such as salmon, trout and eel (mid Oct – Mid April) but will fall within the spawning season for several species of fish which are offered protection under the Natural Environment and Rural Communities Act. Spawning periods for these species are generally between March and July. Phase 1 works are programmed to commence in Mid June 2020 (this date may be subject to change due to the ongoing COVID 19 Pandemic. Mitigation will be updated accordingly if this is the situation) Works under this phase will commence with compound set up and the placement of gabion baskets around the uprights of the viaduct piers. This will commence from the shoreline working towards the river. By the time these works approach the low tide river channel, the spawning season for these fish will be over. Works will be undertaken within the estuary during the 2021 spawning season for protected and migratory fish. Mitigation of impacts from these works will be difficult but the largest mitigating factors are: - No works are to be undertaken to the stone / steel section of the viaduct, traversing the river channel section of the estuary. It is likely that the majority of fish commuting along the estuary will utilise this channel. - Works within the estuary during low tide at bed level will be localised and low impact and will not involve deep excavation or dredging;	Works have potential to cause a Minor Significant impact.

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
	- The viaduct is currently used by trains and a significant of pedestrians, particularly during the summer months. This implies that fish within the estuary are habituated to noise and vibration from the structure. Noise and vibration during the works will be of a greater magnitude and longer duration, particularly during the two blockades. Complete mitigation of these impacts will be difficult but best practice will be used in terms of the construction methodology to limit this i.e. no site radios, modern well silenced plant, use of the Maybey Bridge Temporary Works System to lift sections of the bridge intact to reduce the need for disassembly of elements of the structure and minimise the duration of the works, use of hydraulic cutters as opposed to disc cutters; - Night works are likely during rail blockades. Task lighting will be designed to illuminate the works area but limit light spill into the estuary. This will be achieved through the use of LED flat glass luminaires set at a low level to the viaduct.	
Fish Assemblage - Contamination of the estuary from spillage	See comments under estuarine habitat	Impact Not Likely to be Significant
Biosecurity	A detailed Biosecurity Plan will be prepared for the project. This will include the following: - All site personnel and site visitors will be informed if any INNS are known to be present on site and that they are jointly responsible for preventing their spread/impacts. They will be made aware of what these species look like so they can avoid it where possible and take appropriate actions. - All site personnel and visitors will be inducted in good biosecurity practices. This will include adoption of the CHECK-CLEAN-DRY campaign (NNSS, 2015). - The CHECK-CLEAN-DRY poster will be displayed in the site office as a reminder of good biosecurity practices: - http://www.nonnativespecies.org/checkcleandry/ - All equipment, tools, vehicles and personal protective equipment (PPE) used on site will be checked for seeds originating from any identified INNS before leaving the area. If seeds from identified invasive species are identified, the items will be cleaned and removed seeds will be destroyed. - The spread of waterborne diseases will be limited through the adoption of the CHECK-CLEAN-DRY campaign. This would entail the use of a suitable disinfectant e.g. Virkon® S Aquatic to decontaminate all machinery and PPE prior to it entering site and upon leaving site. Following application of a suitable disinfectant, machinery and PPE will be allowed to fully dry for at least 72 hours before being used on another aquatic site.	Impact Not Likely to be Significant
Blue Mussels - Contamination of the estuary from spillage and increased sediment loading.	See comments under estuarine habitat. The removal of sections of the existing reno (gabion) mattresses, which prevent scour around the piers, is likely to release sand and sediment trapped within the stone of the mattress. Works will be undertaken at low tide and hence these will not be immediately released into the estuary but there is some potential for incoming tides to wash out small volumes of mobilised sediment.	

Potential Hazard	Mitigating Circumstances / Mitigation Measures	Likelihood of Impact with Mitigation
	To quantify this, it is likely that works will be undertaken on a maximum of two piers per tidal cycle using two teams of operatives. The footprint of each work site will be approximately 16m^2.	
Vascular plant assemblage associated with salt marsh (part of estuarine habitat) - No impact	See comments under estuarine habitat -	No impact

8.2 Operation Phase Mitigation

8.2.1 The replacement of sections of the structure will be undertaken on a like for like basis. There is a proposal to omit the concrete shrouds to the bases of the piers as Griffiths Rail have been advised that greenheart wood is not susceptible to attack from shipworm, which has degraded the existing viaduct piers and necessitated the requirement to replace them. This is currently being assessed by Network Rail, but this assessment has assumed that the concrete shrouds will be replaced.

9. WFD Conclusion

9.1.1 Utilising the mitigation practices in the above section, this assessment concludes that the likelihood of significant impact to SAC features in relation to WFD guidance is low and can be controlled in a sensitive manner that respected the long term conservation goals set out for the PLAS SAC and Mawddach SSSI.