# Cardiff Coastal Defences

# Environmental Statement

## Final Report

**September 2021**

CARDIFF
CAERDYDD

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- EIA -

Llywodraeth Cymru
Welsh Government

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## Contract

This report describes work commissioned by Cardiff Council. Hannah Hepworth, Harry Rowlands and Tim Carter of JBA Consulting carried out this work.

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# EIA Quality Mark

This Environmental Statement, and the Environmental Impact Assessment (EIA) carried out to identify the significant environmental effects of the proposed development, was undertaken in line with the EIA Quality Mark Commitments.

The EIA Quality Mark is a voluntary scheme, operated by IEMA, through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

- *EIA Management*
- *EIA Team Capabilities*
- *EIA Regulatory Compliance*
- *EIA Context & Influence*
- *EIA Content*
- *EIA Presentation*
- *Improving EIA practice*

To find out more about the EIA Quality Mark please visit: http://www.iema.net/eia-quality-mark/

# 1 Non-Technical Summary

## 1.1 Background to the proposed development

1.1.1 The Rhymney River is designated as a Site of Importance for Nature Conservation (SINC) and is one of the main rivers that runs through Cardiff, South Wales, starting in Rhymney, located just south of the Brecon Beacons national Park. When it reaches Cardiff, it flows along a wide, meandering course towards its confluence with the Severn Estuary. The Severn Estuary is one of the largest estuaries in Britain located between south Wales and southwest England. The Estuary is protected by UK legislation having been designated as a Special Conservation Area (SAC), Special Protection Area (SPA), Ramsar Site, and as a Site of Special Scientific Interest (SSSI) for a range of habitats and species.

1.1.2 In the past, flood defences were built along the Severn Estuary and part-way up the River Rhymney. These defences included rock armour revetments, a sheet-pile wall, earth embankments and blockstone defences. Today, these defences are severely eroded from tidal and fluvial forces and in some parts completely lost. The remaining defences are at significant risk of failure in the near future and no longer provide flood protection especially with sea level rise predictions.

1.1.3 The proposed scheme is to improve and extend the coastal and fluvial defences along the coastline between the Dwr Cymru Welsh Water (DCWW) Cardiff East Waste Water Treatment Works (WWTW) to the west and the eastern extent of the Lamby Way landfill site to the east (see Figure 1 below). It is anticipated that the project will prevent breaches of the existing defences and reduce erosion and flooding of critical transport, waste management, and energy infrastructure located immediately landward of the scheme. It will also protect extensive residential and commercial areas in the surrounding hinterland.

1.1.4 An Environmental Impact Assessment (EIA) is required for some construction projects when it is thought that they could cause significant environmental effects. The Environmental Impact Assessment identifies, predicts and evaluates the possible environmental effects of the proposed development. The findings of the Environmental Impact Assessment are then presented in an Environmental Statement. This document is the Non-Technical Summary of the Environmental Statement, which explains the findings of the Environmental Statement in non-technical language.

## 1.2 Description of the development site

1.2.1 The proposed development is comprised of new fluvial and coastal flood defences along both banks of the River Rhymney from where the A4232 crosses the river down to the confluence between the river and the Severn Estuary. The defences will then extend along the Severn Estuary coastline, east and west from the River Rhymney. This area includes the DCWW Cardiff East WWTW and the eastern extent of the Lamby Way landfill site (see Figure 1).

1.2.2 The scheme extends over an area of approximately 40ha. To the west of Rhymney River, landward of Rover Way road, land use is a mix of open land, residential land, commercial land, and industrial land. Rover Way itself runs parallel to the coastline and along the eastern bank of the river. It is an important transport route, linking Cardiff city centre with the eastern suburbs of the city and the A48. Along the coastline, west of Rover Way, the Celsa steelworks plant is situated with the adjacent area being used for storage of the waste generated by the plant. On the opposite side of Rover Way, on the Frag Tip, there is a motocross track, while DCWW Cardiff East WWTW is located further south along the road.

1.2.3 To the east of the river Rhymney, Lamby Way landfill extends along the eastern bank of the river and is boarded by Lamby Way to the north. The site has been remediated and landscaped with the majority of the land being developed as a solar farm by Cardiff Council.

1.2.4 The Rhymney River Motor Boat, Sail & Angling Club is located on a narrow bankside area on a large meander of the river close to its confluence with the Severn Estuary. Extensive areas of saltmarsh habitat are located on bankside areas immediately downstream, which provide high-tide roosting for a large number of wintering birds.

1.2.5 The Rhymney River flows along a wide, meandering course from the mainline railway line southwards to its confluence with the Severn Estuary. The channel is approximately 80m wide and contains extensive inter-tidal mudflats exposed at low tide. The Severn Estuary in this area contains a wide, shallow foreshore area, comprising extensive areas of inter-tidal mudflat and smaller areas of fringing saltmarsh habitat. Along the foreshore west of the river, immediately adjacent to higher ground, is a wide area of rocky rubble material, including remnants of building waste (e.g., bricks, slabs, concrete, rebar, etc) that is likely to have been eroded from the Frag Tip. To the east of the river, a rocky substrate is again present in the foreshore area adjacent to higher ground and includes the remnants of earlier rock revetment defences that have failed and eroded.

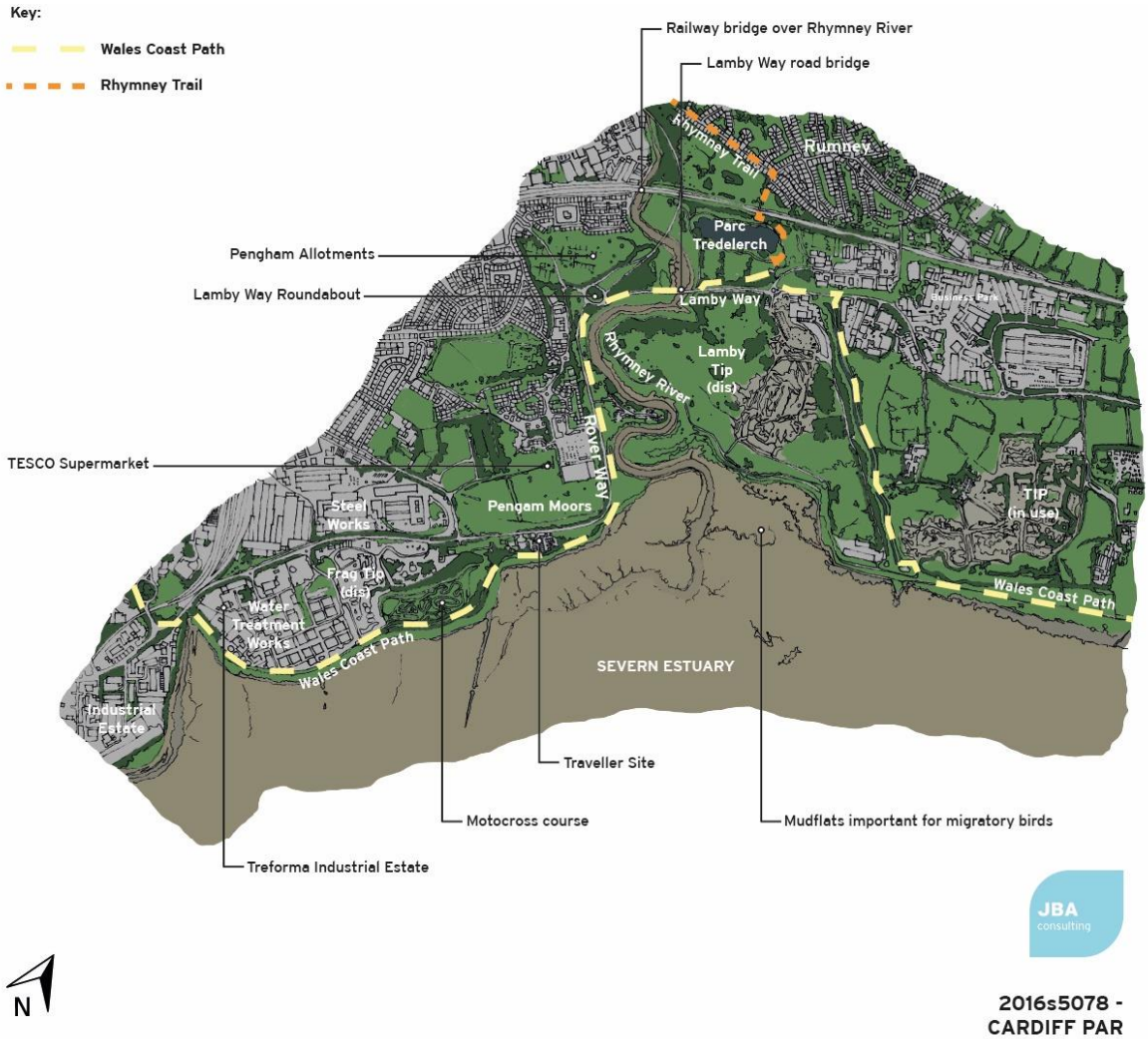


**Figure 1: Location of Rhymney River and its confluence into the Severn Estuary with key features.**

1.2.6 The defences along the Severn Estuary coastline to the west of the Rhymney River are in very poor condition with erosion occurring at a rapid rate. This is causing landfill material to be deposited into the Severn Estuary from the disused Frag Tip and the Traveller site to be at risk of erosion. Along the riverbank, sea level rise is predicted to cause overtopping of the existing defences causing increased flood risk to properties and key infrastructure. In addition, the Lamby Way roundabout and Rover Way and associated utilities are at risk of being undermined and lost to erosion within 20 years.

1.2.7 The defences along the east bank of the river and along the coastline to the east of the Rhymney River are also at risk of erosion. It is predicted that erosion will increase and impact upon the disused Lamby Way Landfill within 20 years causing landfill material to be released into the Severn Estuary if preventative works are not undertaken. Due to the land elevations being higher on this side of the river the risk of erosion is up to 50m along the coast within 20 years, and 270m by 2117.

## 1.3 Description of the proposed development

1.3.1 The proposed development is anticipated to manage flood risk to 2,326 residential and 204 non-residential properties for over 100 years, as well as preventing erosion of landfill material, key road/rail infrastructure, and the Rover Way Traveller Site.

1.3.2 The scheme has been split into various 'Locations'. Rock armour revetement is proposed at Locations 11 and 12 on the coast. Improvements to earth embankments are proposed at Locations 22,42 and 52. Hybrid erosion protection (including elements of bio-engineering along with concrete erosion protection) is proposed in the remaining locations – Locations 21, 31 and 32. The scheme locations are shown in Figure 2 below.

## 1.4 Construction of the proposed development

1.4.1 The following section provides a high-level construction methodology. Construction is programmed to take approximately 18 months to 2 years to complete and commence in early spring 2022.

***Construction access***

1.4.2 Access for all vehicle types to the west of Rhymney River will be via Rover Way initially and then via an existing access point onto the Frag Tip/motocross track to the west of the Traveller's site.

1.4.3 Access to the east of Rhymney River will be directly from Lamby Way or by turning off onto the existing vehicular entrance to Lamby Way Landfill. The construction vehicles will then access the river sections and Severn Estuary coastline via an existing vehicular access track across the landfill.

1.4.4 To access the construction areas north of the Lamby Way road bridge, vehicles will enter via a new access created off Lamby Way or via an existing vehicular route through the StarGarAllot Community Garden (Pengham allotments).

1.4.5 Most construction materials i.e., sheet piles, earth, etc, will be brought to the construction site via the existing highway network (primarily via Rover Way). Rock will be brought to the site by road.

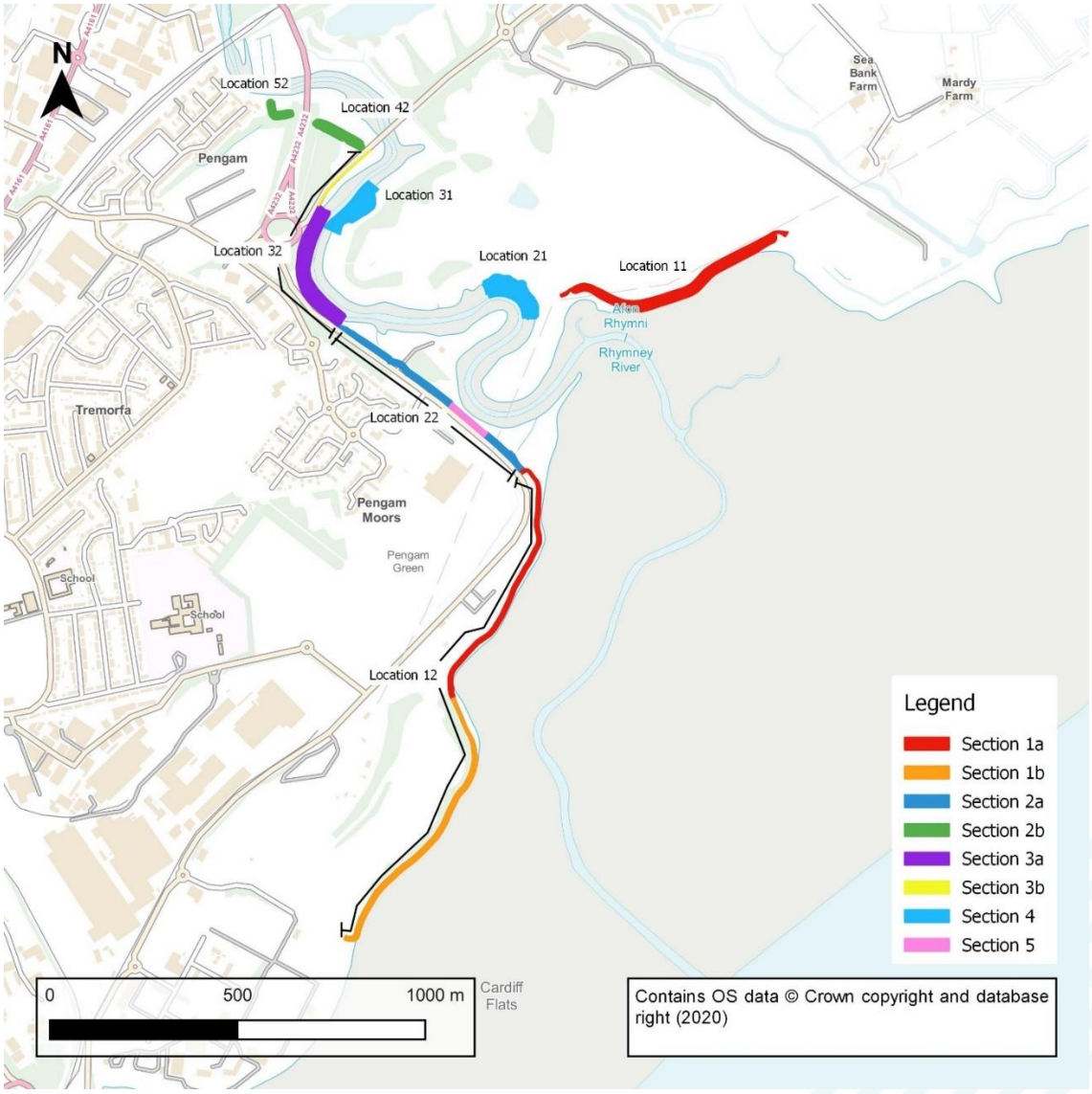


**Figure 2: Overview of the proposed locations and development sections.**

### *Construction traffic management*

1.4.6 To enable certain works at Location 32, namely sheet piling adjacent to the A4232/Lamby Way/Rover Way roundabout, sufficient room will need to be provided in order to create a safe working zone/segregation area between the works and live traffic. This could be achieved by reducing the width of the central roundabout island and installing a temporary running surface to accommodate single width traffic. This may also involve taking up a section of the western verge of Lamby Way to provide a temporary running surface to move the north bound traffic, providing more traffic space. This would enable two lane traffic to be maintained throughout the construction period. This solution is possible as long as the temporary surface is no narrower than 3m wide in order to accommodate HGVs.

1.4.7 Should it not be feasible to reduce lane widths work at this location would be carried out in the off-peak hours between 9.30 am and 3.30 pm to ensure minimal disruption to traffic.

1.4.8 A detailed construction traffic management plan will be prepared prior to construction.

### *Construction site boundary*

1.4.9 The construction site boundary for the proposed development is shown in Figure 3. This includes the footprint of the permanent works, the areas needed to accommodate construction compounds and storage facilities, and the construction access routes from the public highway to be used to facilitate access for construction plant, vehicles and staff.

1.4.10 The total area contained within the site boundary extends to approximately 37ha.

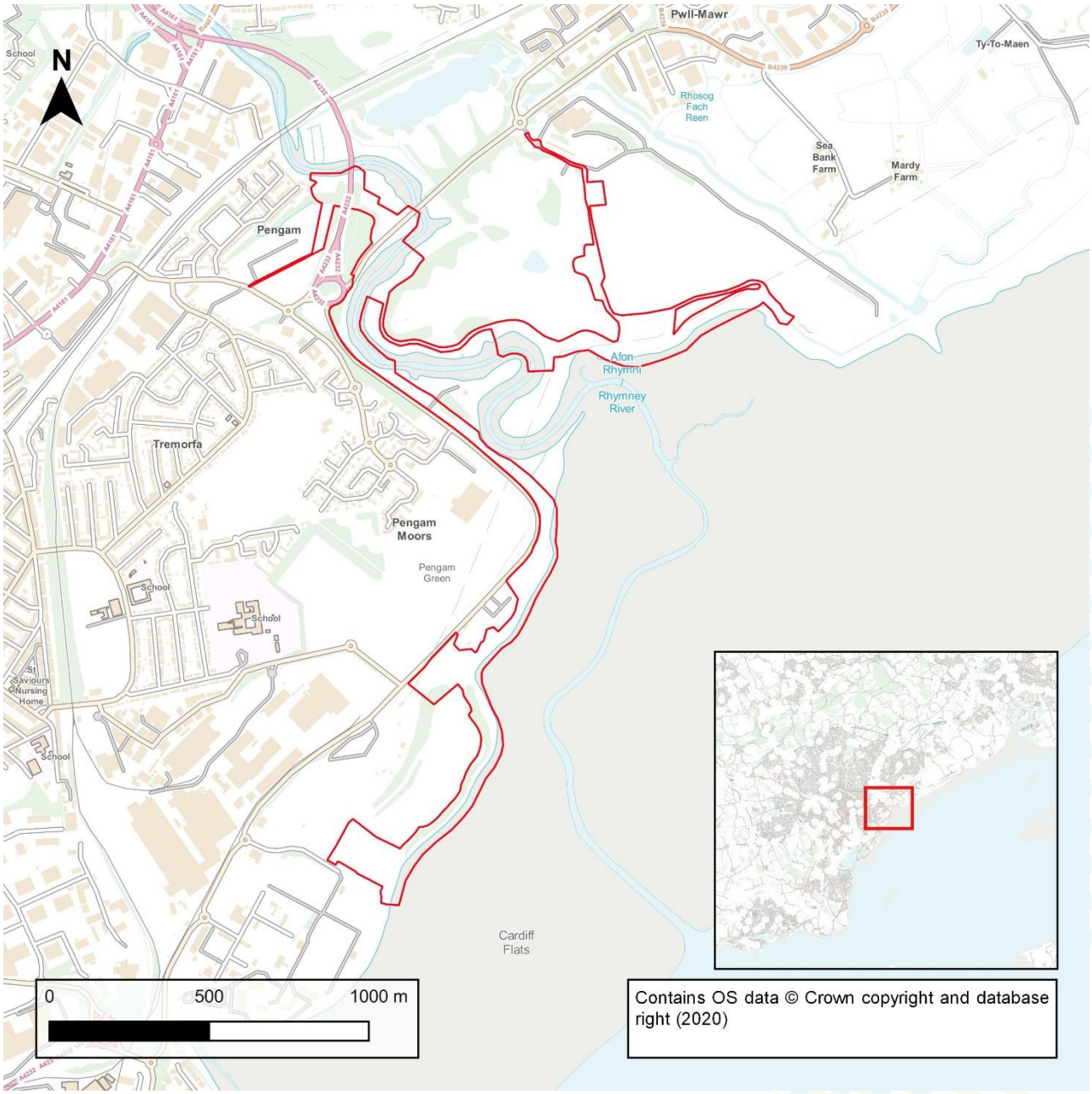


**Figure 3: Proposed construction site boundary.**

## 1.5 Operation of the proposed development

1.5.1 The scheme will manage and reduce erosion along the coast to reduce the risk of failing coastal flood defences and the release of contaminated landfill material into the Severn Estuary from Lamby Way Tip and the Rover Way Frag Tip, in the immediate future and over the next 100 years. It will also reduce and manage the flood risk to 2,842 residential properties and 291 commercial properties over the same period.

1.5.2 Given the hard-engineered composition of the scheme the structure would require minimal maintenance over the 100-year design life of the scheme. Apart from occasional patch repairs, vegetation management and bi-annual condition assessments, it is unlikely that there would be any significant maintenance requirements during operation of the scheme.

## 1.6 Summary of potential environmental impacts of the proposed development

### Water environment

***Potential impacts and proposed mitigation measures***

***Construction Impacts***

1.6.1 The construction of the defences will take place either above tidal areas or under dry conditions. No material will be stored on the foreshore. The works will therefore have No Significant Effect upon the local hydrodynamic regime.

1.6.2 There is a limited risk that works at some locations may mobilise beach sediment into the sea. Any resulting sediment mobilisation during excavation is considered to be fairly minor in the context of high levels of suspended sediment within the Severn Estuary (approximately 30 million tonnes on a spring tide) and highly unlikely to cause permanent or temporary sediment plumes. Therefore, it is considered that the construction of the defences will have No Significant Impact on the sediment regime of the River Rhymney and the wider Severn Estuary.

1.6.3 As the majority of works are located out of the tidal zone, there are unlikely to be any indirect geomorphological impacts on intertidal habitats during construction. Therefore it is considered that the construction of the defences will have No Significant Effect on intertidal habitat within the estuary, through indirect geomorphological processes.

***Operational impacts***

1.6.4 Due to the majority of the defences being located above tidal areas, the limited wave action within the Rhymney and the design of the defences, it is considered that the defences have a low impact score on local hydrodynamics. In addition, the coastal processes are of low sensitivity. Thus, it is considered that the operation of the defence will have No Significant Effect on hydrodynamics within the estuary.

1.6.5 Dycel Block scour protection at some locations will cut off the intertidal bank from the sediment budget of the Severn Estuary. However, due to the small footprint of the defences, any sediment affected will represent a negligible contribution to the overall suspended sediment load of the Severn Estuary. It is therefore unlikely that operation of the defences will have any effect on the sediment regime in the Rhymney or the wider estuary.

1.6.6 Due to the anticipated minimal impact upon the sediment regime by the defences, it is also considered unlikely that the construction of the defences will have any effect on intertidal habitat within the estuary through geomorphological processes.

### *Mitigation Measures*

1.6.7 Potential coastal process impacts would be mitigated through the adoption of good construction practices. As much work as possible will be non-tidal (i.e. undertaken above the Mean High Water Springs (MHWS) level or during periods that allow for dry working).

1.6.8 No material would be stored on the foreshore, to reduce the risk of scour to adjacent intertidal habitat.

## Biodiversity and nature conservation

### *Baseline conditions*

1.6.9 The Severn Estuary European Marine Site (EMS) is designated as a SPA, SAC, and Ramsar site, with a further six statutory designated sites located within 5km of the proposed development. In addition to the statutory designated sites, there are five non-statutory designated sites located within 1km of the proposed development. These are referred to as Sites of Importance for Nature Conservation (SINCs).

### *Potential impacts and proposed mitigation measures*

### *Protected sites*

1.6.10 During construction, there is potential to impact upon the features of the Severn Estuary European Marine Site. Construction may disturb wintering wildfowl and wading bird species, if the works are carried out during the wintering period. Plant movement has the potential to negatively impact intertidal habitats through compaction of the foreshore. In addition, there is the potential to negatively impact intertidal and subtidal habitats through pollution incidents.

1.6.11 During operation, there is potential for the defences to cause coastal squeeze. It is estimated the total intertidal habitat lost as a result of the scheme to be 1.75 Ha.

### *Habitats*

1.6.12 The permanent works footprint will directly impact approximately 1.41ha of intertidal habitat in the Severn Estuary and 0.94 ha of intertidal habitat in the Rhymney River. The scheme will directly impact 1.59 ha of saltmarsh and has the potential to further impact saltmarsh and intertidal mudflats in the Rhymney and the Severn through the provision of access tracks and site compounds

### *Birds*

1.6.13 During construction, there is the potential to disturb these wintering wildfowl and wading bird species should the project impact upon the foreshore areas. Additionally, re-routing the Wales Coast Path either temporarily or permanently has the potential to disturb wintering and migratory birds if the path results in walkers breaking the skyline. However, no change to the route of the Path is proposed.

### *Mitigation*

1.6.14 Any habitat lost as a result of the defence footprint and coastal squeeze will be replaced with compensatory habitat.

## Landscape and visual

1.6.15 Much of the site lies on the edge of National Landscape Character Area 35, Cardiff,

Barry and Newport. Part of the site lies on the far western edge of National Landscape Character Area 34, Gwent Levels. The site is also just to the west of The Gwent Levels, a Registered Landscape of Outstanding and of Special Interest in Wales. This has been designated due to its extraordinarily diverse environmental and archaeological potential. The site is part of Marine Character Area 29 Severn Estuary (Wales).

***Potential impacts and proposed mitigation measures***

1.6.16 During the construction phase, there will be slight effects to landscape features and landscape character due to the operation of machinery and excavation of landscape features including the riverbanks and channel. There will be moderate impacts upon the coastal area resulting from significant increases in noise pollution during construction activities. This disturbance will also have a moderate-substantial adverse impact on receptors on the Wales Coast Path (WCP) and Public Rights of Way (PRoW).

1.6.17 During the operational phase there will be slight beneficial impacts upon the coastal area due to an improvement in the appearance of man-made coastal defences. The defences will have a slight adverse effect upon the river, although these impacts will reduce once mud begins to accrete on the surface. There will continue to be slight-moderate adverse effect upon trees as colonisation of the bare earth will take time.

1.6.18 After 15 years, the accretion of mud will have helped blend the defences into the natural environment, thus the visual impact on the river will be negligible. Trees will have grown in stature by this stage and thus the visual impact will reduce. Impacts upon urban areas will be negligible.

1.6.19 Residents of the Traveller site on Rover Way will continue to be able to see walkers on the WCP/PRoW, though this may have reduced slightly over time with some natural vegetation growth along the boundary between the site and the coast. Effects on most other receptors at this point are likely to be negligible.

***Mitigation measures***

1.6.20 The mitigation options are likely to be limited during the construction period and will rely on good construction practices to limit the disturbance to landscape and visual receptors. Advance seeding/planting may be possible in certain areas to help to minimise any adverse effects during this phase.

***The Queen's Gate Roundabout***

1.6.21 Trees and vegetation lost in this area during the works will be replaced with new planting that is designed to integrate with the species that remain, to provide visual interest, and to provide some screening of the busy road network for those using the WCP/PRoW. The planting will make a positive contribution to the overall landscape character of the area.

***The Traveller Site***

1.6.22 There will be planting to provide a natural screen between the Traveller Site and the WCP/PRoW. By Year 15 in winter the new planting will be providing an improvement to the baseline with visual interest, as well as acting as a visual screen, and adding a positive landscape feature to the landscape character in this area.

1.6.23 In addition, a privacy fence will be installed between the Traveller site and the WCP/PRoW so that walkers on the footpath cannot be seen by the residents, and vice versa.

### Historic environment

#### *Baseline conditions*

1.6.24 Designated heritage assets include World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Protected Wreck Sites, Registered Parks and Gardens and Registered Battlefields. There are no designated heritage assets within the study area.

1.6.25 The wider study area contains several designated heritage assets, but none of these will be significantly affected by the scheme. The known assets include:

- The Grade II listed Rumney Pottery, approximately 400m north-west of the site;
- Three conservation areas: Roath Mill Gardens, Roath Park and Oakfield Street are all located between 1.3km-1.8km to the west of the site. All of the conservation areas contain Grade I and II Listed Buildings;
- The Relict Seawall on Rhymney Great Wharf located c.800m to the east of the site extent and is a Scheduled Monument; and
- The Gwent Levels.

#### *Potential impacts and proposed mitigation measures*

1.6.26 There will be no direct or indirect impacts on any designated heritage assets as a result of the proposed works.

1.6.27 Mitigation of impacts to these assets will involve fencing to protect from vehicle movements or accidental damage during construction. The type of fencing and buffer distance around the assets will be confirmed prior to construction beginning.

1.6.28 Groundbreaking at some locations will be through tidal flat deposits. There is a risk of encountering unknown archaeological remains in these deposits.

1.6.29 It is recommended that any further pre-construction ground investigation works are monitored and the results analysed to further determine the potential for encountering unknown archaeological remains and palaeoenvironmental deposits.

1.6.30 The operation of the proposed scheme will have a neutral impact upon the setting of the Gwent Levels. During the construction phase, however, vehicle movements along access routes and on the foreshore, plant activity and storage of materials will have a temporary minor impact upon the setting of the Gwent Levels.

### Climate Change

#### *Future Baseline*

1.6.31 UKCP18 climate projections predict:

- A move towards warmer, wetter winters and hotter, drier summers;
- Increases in wind speeds over the UK for the second half of the 21st century for the winter season; and
- An increase in UK coastal flood risk under all emission scenarios, generally due to the effects of sea level rise and an increase in the frequency and magnitude of severe weather events.

#### *During Operation*

1.6.32 A climate emergency plan and procedure will need to be developed by the operator

that includes a plan and risk assessment for each of the potential climate hazards that could impact the operation of the defences.

1.6.33 Additional mitigation measures that may be relevant to the operation includes the development of a detailed monitoring regime for the flood defence. Included as part of this would likely be:

- Ensuring a full inspection of the assets is completed following any storm event/adverse weather, checking for any damage to the assets.
- Repairing any damage found on the assets as quickly as possible to minimise any adverse effects resulting from additional adverse weather.

## 1.7 Conclusions of the environmental impact assessment

1.7.1 The main environmental impact of the scheme will be disruption to and a permanent loss of some of the River Rhymney mudflats due to installation of concrete erosion protection. The amount of loss has been minimised by restricting the lengths of the river bank that are to be protected and including bio-engineering options for erosion control. Over time it is hoped that the existing mud habitat will re-establish along this section of the Rhymney.

1.7.2 At Locations 11 and 12 the existing shorelines will be replaced with rock armour, changing the character of these areas and resulting in the loss of small areas of saltmarsh. However, the rock armour will provide erosion protection to this section of coast.

1.7.3 Construction will result in a change to local landscape character and an impact on local views for local residents and those using the Wales Coast Path. Replacement planting will be undertaken to replace trees and scrub affected by construction of the scheme.

***Construction environmental management***

1.7.4 An Outline Construction Environmental Management Plan will be produced to assist with the implementation of construction mitigation identified in the Environmental Statement. It will include the key environmental management recommendations identified for the construction phase of the Cardiff project in the Environmental Statement.

## Contents

## List of figures



## List of tables

## Abbreviations

| | |
|---|---|
| AADF | Average Annual Daily Flow |
| AOD | Above Ordnance Datum |
| AONB | Area of Outstanding Natural Beauty |
| BAP | Biodiversity Action Plan |
| BGL | Below Ground Level |
| CEMP | Construction Environmental Management Plan |

| | |
|---|---|
| CIEEM | Chartered Institute of Ecology and Environmental Management |
| CIRIA | Construction Industry Research and Innovation Association |
| CMS | Construction Method Statement |
| CPRE | Campaign to Protect Rural England |
| CRTN | Calculation of Road Traffic Noise |
| Defra | Department for Environment, Food and Rural Affairs |
| EA | Environment Agency |
| EC | European Commission |
| EcIA | Ecological Impact Assessment |
| EIA | Environmental Impact Assessment |
| EMS | Environmental Management System |
| ES | Environmental Statement |
| EU | European Union |
| GHG | Greenhouse Gas |
| FRA | Flood Risk Assessment |
| HER | Historic Environment Record |
| HGV | Heavy Goods Vehicles |
| IAQM | Institute of Air Quality Management |
| IEMA | Institution of Environmental Management and Assessment |
| LBAP | Local Biodiversity Action Plan |
| LFRMS | Local Flood Risk Management Strategy |
| LLFA | Lead Local Flood Authority |
| LPA | Local Planning Authority |
| LULUCF | Land Use, Land Use Change and Forestry |
| LWS | Local Wildlife Site |
| MA | Management Area |
| MAGIC | Multi-Agency Geographical Information for the Countryside |
| NAI | No Active Intervention |
| NERC | Natural Environment and Rural Communities Act |
| NMP | National Mapping Programme |
| NNR | National Nature Reserve |
| NPPF | National Planning Policy Framework |
| NPPG | National Planning Policy Guidance |
| NRHE | National Record of the Historic Environment |
| NTS | Non-Technical Summary |
| PDA | Proposed Development Areas |
| PDZ | Policy Development Zone |
| PEA | Preliminary Ecological Appraisal |
| PPS | Planning Policy Statement |
| PU | Policy Unit |
| RC | Reinforced Concrete |
| SAC | Special Area of Conservation |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| UKCP09 | United Kingdom Climate Projections 2009 |
| UKCP18 | United Kingdom Climate Projections 2018 |

| | |
|---|---|
| WFD | Water Framework Directive |

# 1 Introduction

## 1.1 Background to the proposed development

1.1.1 The Rhymney River is designated as a Site of Importance for Nature Conservation (SINC) and is one of the main rivers that runs through Cardiff, South Wales, starting in Rhymney, located just south of the Brecon Beacons National Park. When it reaches Cardiff, the Rhymney flows along a wide, meandering course towards its confluence with the Severn Estuary. The Severn Estuary is one of the largest estuaries in Britain located between South Wales and southwest England. As part of the national site network, the Severn Estuary is protected by UK legislation having been designated as a Special Conservation Area (SAC), Special Protection Area (SPA), Ramsar Site, and as a Site of Special Scientific Interest (SSSI) for a range of habitats and species.

1.1.2 In the past, flood defences were built along the Severn Estuary and part-way up the River Rhymney. These defences were composed of rock armour revetments, a sheet-pile wall, earth embankments, and blockstone defences. Today, these defences are severely eroded from tidal and fluvial forces and in some parts completely lost. It has been concluded that the remaining defences are at significant risk of failure in the near future and no longer provide flood protection especially with sea level rise predictions.

1.1.3 The proposed scheme is to improve and extend coastal and fluvial defences along the coastline between the Dwr Cymru Welsh Water (DCWW) Cardiff East Waste Water Treatment Works (WWTW) to the west and the eastern extent of the Lamby Way landfill site to the east. It is anticipated that the project will prevent breaches of the existing defences, reducing erosion and flooding of critical transport, waste management, and energy infrastructure located immediately landward of the scheme, and of extensive residential and commercial areas in the surrounding hinterland.

1.1.4 Environmental Impact Assessment (EIA) is a systematic process to identify, predict and evaluate the environmental effects of proposed actions and projects1, undertaken by the developer where the characteristics and/or location of a proposed development project would result in likely significant effects on the environment2.

1.1.5 The findings of the EIA process are documented in an Environmental Statement (ES) (this report), which forms part of the planning application for the proposed development. The circumstances under which the development project has been subject to the EIA process and the way in which the ES has been prepared are a statutory requirement.

1.1.6 A non-technical summary of the outcomes of the EIA is also included in this report.

## 1.2 Description of the development site

1.2.1 The proposed development comprises of new fluvial and coastal flood defences along both banks of the River Rhymney from where the A4232 crosses the river down to the confluence between the river and the Severn Estuary. The defences will then extend along the Severn Estuary coastline, east and west from the River Rhymney. This area includes the DCWW Cardiff East WWTW and northwards along the eastern extent of the Lamby Way landfill site (see Figure 1).

1.2.2 The scheme extends over an area of approximately 40ha. To the west of Rhymney

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[1] Sadler B. & Fuller K. (2002). UNEP Environmental Impact Assessment Training Resource Manual. 2nd Edition.

[2] Ministry of Housing, Communities & Local Government (2019). Environmental Impact Assessment Guidance, 15 March 2019. Available online: https://www.gov.uk/guidance/environmental-impact-assessment [Accessed 20/05/2019].

River, landward of Rover Way, land use is a mix of open land, residential land, commercial land, and industrial land. Rover Way itself runs parallel to the coastline and along the eastern bank of the river. It is an important transport route, linking Cardiff city centre with the eastern suburbs of the city and the A48. Along the coastline, west of Rover Way, the Celsa steelworks plant is situated with the adjacent area being used for storage of the waste generated by the plant. On the opposite side of Rover Way, the Cardiff Motocross centre operates on the land while further south along the road, DCWW Cardiff East WWTW is located.

1.2.3 To the east of the river Rhymney, Lamby Way landfill is situated where it extends along the eastern bank of the river and boarded by Lamby Way road to the north. The site has been remediated and landscaped with the majority of the land being developed as a solar farm by Cardiff Council.

1.2.4 The Rhymney River Motor Boat, Sail & Angling Club is located on a narrow bankside area on a large meander of the river close to its confluence with the Severn Estuary, with extensive areas of saltmarsh habitat located on bankside areas immediately downstream, which provide high-tide roosting for a large number of wintering birds.

1.2.5 The Rhymney River flows along a wide, meandering course from the mainline railway line southwards to its confluence with the Severn Estuary. The channel is approximately 80m wide and contains extensive inter-tidal mudflats exposed at low tide. The Severn Estuary in this area contains a wide, shallow foreshore area, comprising extensive areas of inter-tidal mudflat and smaller areas of fringing saltmarsh habitat. Along the foreshore west of the river, immediately adjacent to higher ground, is a wide area of rocky rubble material, including remnants of building waste (e.g., bricks, slabs, concrete, rebar, etc) that is likely to have been eroded from the Frag Tip. To the east of the river, a rocky substrate is again present in the foreshore area adjacent to higher ground and includes the remnants of earlier rock revetment defences that have failed and eroded.

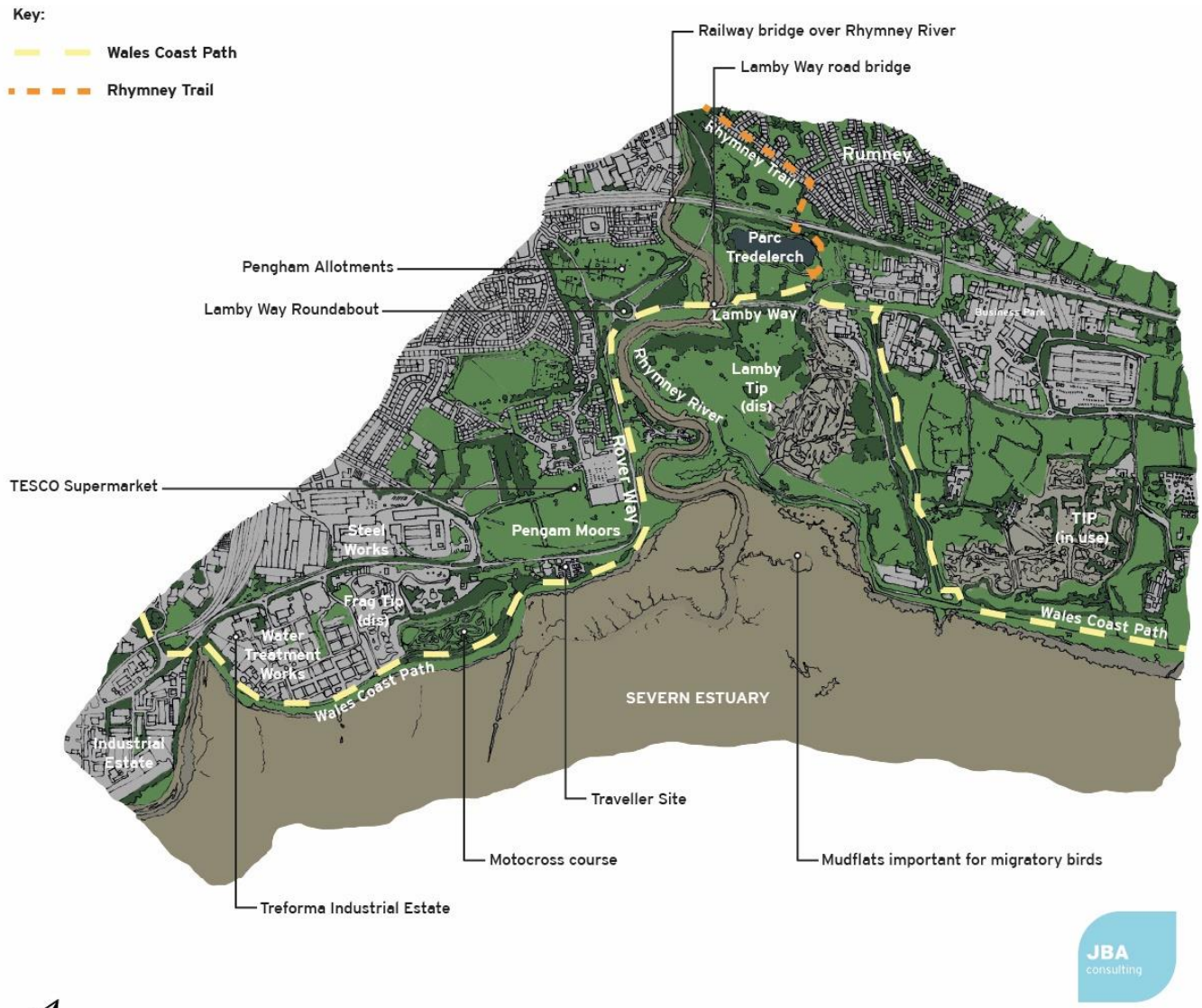


**Figure 1-1: Location of Rhymney River and its confluence into the Severn Estuary with key features.**

1.2.6 The defences along the Severn Estuary coastline to the west of Rhymney River are in very poor condition with erosion occurring at a rapid rate. This is causing landfill material to be deposited into the Severn Estuary from the disused Frag Tip and the Travelers site to be at risk of disappearance. Along the river bank, sea level rise is predicted to cause overtopping of the existing defences causing increased flood risk to properties and key infrastructure. In addition, the Lamby Way roundabout and Rover Way are at risk of being undermined and lost to erosion within 20 years.

1.2.7 The defences along the east bank of the river and along the coastline to the east of the Rhymney River are also at risk of erosion. It is predicted that erosion will increase and impact upon the disused Lamby Way Landfill within 20 years causing landfill material to be released into the Severn Estuary if preventative works are not undertaken. Due to the land elevations being higher on this side of the river, flood risk will be limited however, the risk of erosion is up to 50m along the coast within 20 years, and 270m by 2117.

1.2.8 Photographs of Rhymney River and the Severn Estuary are shown in Table 1-1.

**Table 1-1: Photographs of the proposed development area and adjacent areas**

| Viewpoint | Viewpoint photograph | Description |
|---|---|---|
| **1** |  | View of the Rhymney River looking westwards (upstream) towards the residential properties at Glan Rhymni between the railway bridge and the A4232 road bridge. |
| **2** |  | View of the Rhymney River looking eastwards (downstream), with the A4232 road bridge in the background. |
| **3** |  | View of the Rhymney River looking northwards (upstream) towards the A4232 road bridge. |
| **4** |  | View of the Rhymney River looking northwards (upstream) with the Lamby Way road bridge in the background. |

| Viewpoint | Viewpoint photograph | Description |
|---|---|---|
| **5** |  | View of the Rhymney River looking south westwards (downstream) with the Rover Way/Lamby Way/A4232 roundabout in the background. |
| **6** |  | View of the Rhymney River looking northwards (upstream) from the with the Rover Way/Lamby Way/A4232 roundabout in the background. |
| **7** |  | View of the Rhymney River looking south (downstream) towards the Rhymney River Motor Boat, Sail and Angling Club. |
| **8** |  | View of the Rhymney River Motor Boat, Sail and Angling Club located on the west bank of the Rhymney River with the Severn Estuary in the background. |

| Viewpoint | Viewpoint photograph | Description |
|---|---|---|
| **9** |  | View looking northwards towards the Severn Estuary foreshore west of the Rhymney River with the Rover Way Traveller site in the background. |
| **10** |  | View looking northwards towards the Severn Estuary foreshore east of the Rhymney River with the Lamby Way Landfill site in the background. |

## 1.3 Legislative basis of the Environmental Statement

1.3.1 The requirement for assessment of the effects of certain public and private projects on the environment is set out in European and UK law. European Council (EC) Directive No. 85/337/EEC[3], as amended by EC Directive No. 97/11/EC[4], EC Directive No. 2011/92/EU[5] and EC No. Directive 2014/52/EU[6] (hereafter collectively referred to as 'the EIA Directive'), under Article 5(1) states: 'Where an environmental impact assessment is required, the developer shall prepare and submit an environmental impact assessment report.'

1.3.2 The EIA Directive is transposed into UK law through the EIA Regulations. These are a series of statutory instruments that set out regulations for implementing the EIA Directive through specific consenting regimes. The development proposals require consent under the Town & Country Planning Act 1990 and the Marine & Coastal Access Act 2009, and therefore fall within the requirements of both the Town & Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (W136), and the Marine Works (Environmental Impact Assessment) Regulations 2007 (SI 2007/1518) (as amended 2011, 2015, 2017). Regulation 5 of the 2017 Town & Country

[3] EC Directive 85/337/EEC if 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, Official Journal of the European Union No. L 175, 05/07/1985.

[4] EC Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. Official Journal of the European Union No. L 073, 14/03/1997.

[5] EC Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of effects of certain public and private projects on the environment. Official Journal of the European Union L 26, 28/1/2012.

[6] EC Directive 2014/52/EU of 6 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, Official Journal of the European Union No. L 124/1, 25/4/2014.

Planning EIA Regulations sets out the provisions relating to screening EIA Development, and Regulations 7 and 8 of the 2007 Marine Works EIA Regulations set out the requirement for screening of EIA Directive Annex I and II Projects.

1.3.3 A combined EIA Screening and Scoping Opinion request was made on the 19th February 2021 to the Marine Licencing team at NRW and on the 23rd February 2021 to Cardiff Council. It was determined by NRW on 14th April 2021 that the proposed scheme falls within Schedule A2, paragraph 69 of the above regulations and therefore must be considered in terms of size, nature and location having regard to the relevant criteria set out in Schedule 1 of the Marine Works EIA Regulations. It was determined by Cardiff Council on the 16th April 2021 that the scheme falls within Schedule 2, Paragraph 10(h), and Schedule 3 of the Town and Country Planning EIA Regulations, and would also therefore require statutory EIA.

1.3.4 The Council confirmed that it was in agreement with the proposed scope of the EIA as set out in the scoping report, subject to the inclusion of a number of specific additional issues. A copy of the scoping opinion is provided in Appendix B. Further details on the outcomes of the EIA screening and scoping processes are provided in Section 3.2 below.

## 1.4 Scope and content of the Environmental Statement

1.4.1 The combined EIA screening and Scoping Report considered the potential significant effects associated with the proposed development. On the basis of this and in accordance with the requirements placed upon the developer in the EIA Regulations, an appropriate content of the ES has been developed and is presented below.

1.4.2 In accordance with Regulation 17(3) of the Town & Country Planning EIA Regulations, the ES contains:

> *"(a) a description of the proposed development comprising information on the site, design, size and other relevant features of the development;*
>
> *(b) a description of the likely significant effects of the proposed development on the environment;*
>
> *(c) a description of any features of the proposed development, or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*
>
> *(d) a description of the reasonable alternatives studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment;*
>
> *(e) a non-technical summary of the information referred to in sub-paragraphs (a) to (d); and*
>
> *(f) any additional information specified in Schedule 4 relevant to the specific characteristics of the particular development or type of development and to the environmental features likely to be significantly affected."*

1.4.3 The non-technical summary (NTS), provided at the start of this ES, is intended to inform those who have an interest in the development, but who are not concerned with the detail of the technical assessment provided in the ES. It summarises the proposals, its likely significant environmental effects and the proposed mitigating measures in non-technical language.

1.4.4 The ES is organised on an environmental topic basis as set out in Regulation 4(2). For each environmental topic, topic-specific baseline conditions have been collected and used to inform the assessment, and the potential impacts and likely significant effects of the proposed development on the environment have been determined for each of

the scoped in environmental issues, plus any relevant additional information that has come to attention. Mitigation measures are proposed to reduce the significance of effects where possible, and the resulting residual effect is reported. The approach to EIA is iterative, whereby the assessment and ongoing consultation with stakeholders influence the design evolution of the development proposals (see Section 2.4). Further detail on the EIA process is provided in Section 3.1.

1.4.5 For consistency and ease of cross reference, each environmental topic chapter presented in the ES are structured using the following section headings:

1 Introduction
2 Baseline Conditions
3 Assessment Methodology and Significance Criteria
4 Potential Impacts and Significant Effects
5 Mitigation Measures
6 Residual effects

1.4.6 The structure of the ES is set out in Table 1-2.

**Table 1-2: Structure of the ES**

| ES section | Section title |
|---|---|
| **Non-Technical Summary** | |
| **Chapter 1** | **Introduction** |
| 1.1 | Background to the proposed development |
| 1.2 | Description of the development site |
| 1.3 | Legislative basis of the Environmental Statement |
| 1.4 | Scope and content of the Environmental Statement |
| **Chapter 2** | **Proposed development** |
| 2.1 | Need for the proposed development |
| 2.2 | Identification of the preferred option for the proposed development |
| 2.3 | Ground Contamination |
| 2.4 | Detailed design of the proposed development |
| 2.5 | Outline construction methodology |
| 2.6 | Operational requirements and decommissioning |
| 2.7 | Planning policy context |
| 2.8 | Environmental constraints |
| **Chapter 3** | **Environmental impact assessment methodology** |
| 3.1 | The EIA process |
| 3.2 | EIA screening and scoping |
| 3.3 | The Environmental Statement |
| 3.4 | EIA method of assessment |
| **Chapter 4** | **Geomorphology and Coastal Processes** |
| **Chapter 5** | **Biodiversity and Nature conservation** |
| **Chapter 6** | **Landscape** |
| **Chapter 7** | **Historic environment** |
| **Chapter 8** | **Climate Change** |
| **Chapter 9** | **Cumulative Effects** |
| **Chapter 10** | **Conclusions** |
| 10.1 | EIA outcomes |
| 10.2 | Construction environmental management |

# 2 Proposed development

## 2.1 Need for the proposed development

2.1.1 Existing flood defences in the scheme area, located along the Severn Estuary and the Rhymney River, have failed or are at significant risk of failing. Much of the coastline across the project area is eroding and with predicted sea level rise due to climate change, the flood and erosion risk will increase into the future. The proposed scheme will manage flood risk to 2,326 residential and 204 non-residential properties over 100 years, as well as preventing erosion of landfill material, key road/rail infrastructure, and the Rover Way Traveller Site.

2.1.2 This scheme is comprised of two main areas:

***Flood cell to the west of the Rhymney River***

2.1.3 The coastal defences along this section of the Severn Estuary are in very poor condition and erosion is taking place at a rapid rate. Landfill material is eroding into the Severn Estuary from the disused Frag Tip, while the Rover Way Traveller Site is at risk of being lost to erosion and flooding. The coastal defences here are already at risk of breach due to erosion, leading to flooding of the land behind.

2.1.4 Along the west bank of the river there are low sections of defence which will overtop as sea levels rise, increasing flood risk to people and property to the west of the river. The Lamby Way roundabout and Rover Way, key infrastructure supporting the economy of Cardiff, are situated immediately behind the embankment on the outside of the river meander and are at risk of being undermined and lost to erosion within 20 years.

2.1.5 Here people and property are at risk from coastal erosion and flooding from the sea. In addition, fluvial erosion and tidal flooding can occur from the River Rhymney. The frequency and likelihood of both significantly increases in the future as a result of climate change.

### *2.1.6 Flood cell to the east of the Rhymney River*

2.1.7 The defences along the east bank of the river and the coastal defences to the east of the river mouth are also at risk of erosion. It is estimated that if no works are undertaken along the coast, erosion will continue to increase and will impact upon the disused Lamby Way Landfill within 20 years, releasing landfill material into the Severn Estuary and having significant environmental impacts. Land elevations are higher on this side of the river leading to more limited flood risk, but there is a risk of up to 50m of erosion along the coast within 20 years, and 270m by 2119.

2.1.8 The two flood cells have been combined into one scheme due to their geographic proximity and the similarities in the works required. Significant efficiencies can be realised in undertaking these works as one scheme, both during design and construction. The flood risk is predicted to increase in the future with the effects of climate change, leading to over 2,656 residential and 294 non-residential properties being at risk in the year 2119 if the flood risk is not managed (see Table 2-1 and Figure 2-1).

**Table 2-1: Number of properties affected at different flood return periods without flood management**

| | | Return period | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Property | 2 | 10 | 20 | 50 | 75 | 100 | 200 | 1000 |
| 2019 | Residential | 1 | 1 | 1 | 1 | 294 | 338 | 411 | 935 |
| | Non-residential | 0 | 0 | 1 | 1 | 3 | 3 | 5 | 13 |
| 2039 | Residential | 1 | 1 | 1 | 330 | 394 | 429 | 536 | 1,243 |
| | Non-residential | 0 | 1 | 1 | 3 | 3 | 5 | 9 | 67 |
| 2069 | Residential | 0 | 359 | 430 | 551 | 645 | 710 | 1,011 | 2,084 |
| | Non-residential | 1 | 3 | 5 | 9 | 12 | 13 | 29 | 198 |
| 2119 | Residential | 790 | 1,347 | 1,752 | 2,068 | 2,208 | 2,301 | **2,656** | 4,758 |
| | Non-residential | 13 | 36 | 134 | 193 | 223 | 254 | **294** | 461 |

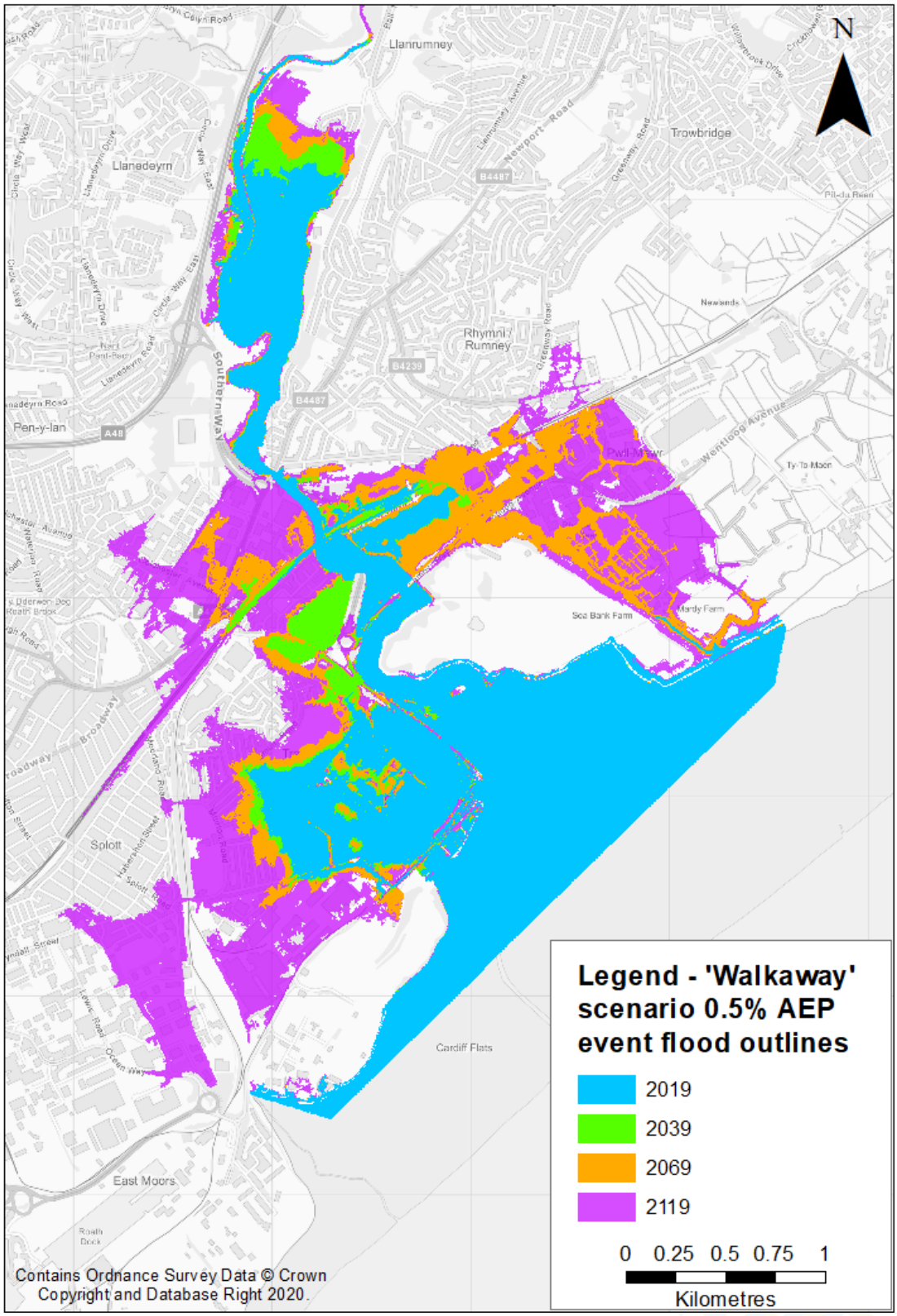


**Figure 2-1: Predicted flood extents up to 0.5% AEP event (2119 Q 200 event)**

2.1.9 The Severn Estuary Shoreline Management Plan (SMP) policy for these sections of the coastline is to 'Hold the Line' (HTL). This means that the flood defences should be maintained and upgraded or replaced in their current position. Therefore, substantial

new flood defences are required to maintain and improve the level of protection currently provided.

## 2.2 Ground contamination

2.2.1 A Phase 1 Geo-Environmental Desk Study has previously been undertaken and an intrusive geotechnical ground investigation was subsequently completed to characterise ground conditions along the line of the proposed defences. A geotechnical assessment was provided in the Ground Investigation Report, with a separate report assessing the risk from contamination, provided in Appendix L.

2.2.2 It was concluded that following a Tier 1 generic risk assessment of the site soils and groundwater, the risks to human health associated with the proposed works are considered to be low and the risks to controlled waters are also low assuming appropriate risk controls and mitigation are put into place.

2.2.3 In Location 12 (Section 6), the rock revetment will limit the potential for future physical erosion of material from the base of the Frag Tip. Also, with the exception of excavation of materials at the crest of the tip no works involving re-profiling or re-engineering of the tip are planned and therefore no specific mitigation measures considered necessary. Where sheet piling is proposed along Rover Way and Lamby Way, a piling works risk assessment is recommended.

2.2.4 The following are planned to be carried out:

- Piling Works Risk Assessment
- A Materials Management Plan in line with CL:AIRE code of practice
- An Environmental Management Plan, or Construction Environmental Action Plan for the works including a watching brief during excavation and construction works to deal with contamination that may be encountered on a "live" basis during groundworks

2.2.5 Due to the low risk presented to human health and controlled waters risk assessment associated with the ground conditions at the site following the necessary mitigation measures, this is not taken forward in the ES.

## 2.3 Identification of the preferred option for the proposed development

### Long-list options development

2.3.1 Cardiff Council has considered and assessed a range of options for the proposed development. This optioneering process initially involved identification of a 'long-list' of options that were subject to technical, economic, and environmental appraisal to assess whether they would achieve the project objectives and supporting critical success factors7. This included extensive engagement with key project stakeholders, including Cardiff Council, NRW, DCWW, and Glamorgan-Gwent Archaeological Trust (GGAT). Figure 2-2 provides a summary of the long-list options. Due to the size of the study area, the defences were divided into sections based upon the type and condition of the defence and the predominant geomorphological processes.

[7] Cardiff Council, 2016. Cardiff Flood and Coastal Erosion Risk Management Outline Business Case, March 2016.

### Short-list options

2.3.2 Several short-list options were selected by Cardiff Council. These were collated from the long-list options after unsuitable options were removed. The short-list options identified are summarised in Table 2-2. These options underwent further detailed technical, environmental, and economic assessment to determine the likely constraints, opportunities, risks, benefits, and costs associated with each option. This assessment process was undertaken in-accordance with Flood and Coastal Risk Management Appraisal Guidance (FCERM-AG)8. This included a wide ranging non-financial benefits appraisal undertaken using Multi-Criteria Analysis (MCA) to identify a non-financial preferred option. The short-listed options were rated against a range of categories (see Table 2-3) designed to assess the relative merits of the proposed options against the project objectives and critical success factors. The outcomes of this work are fully documented in the Outline Business Case (OBC) report for the project.

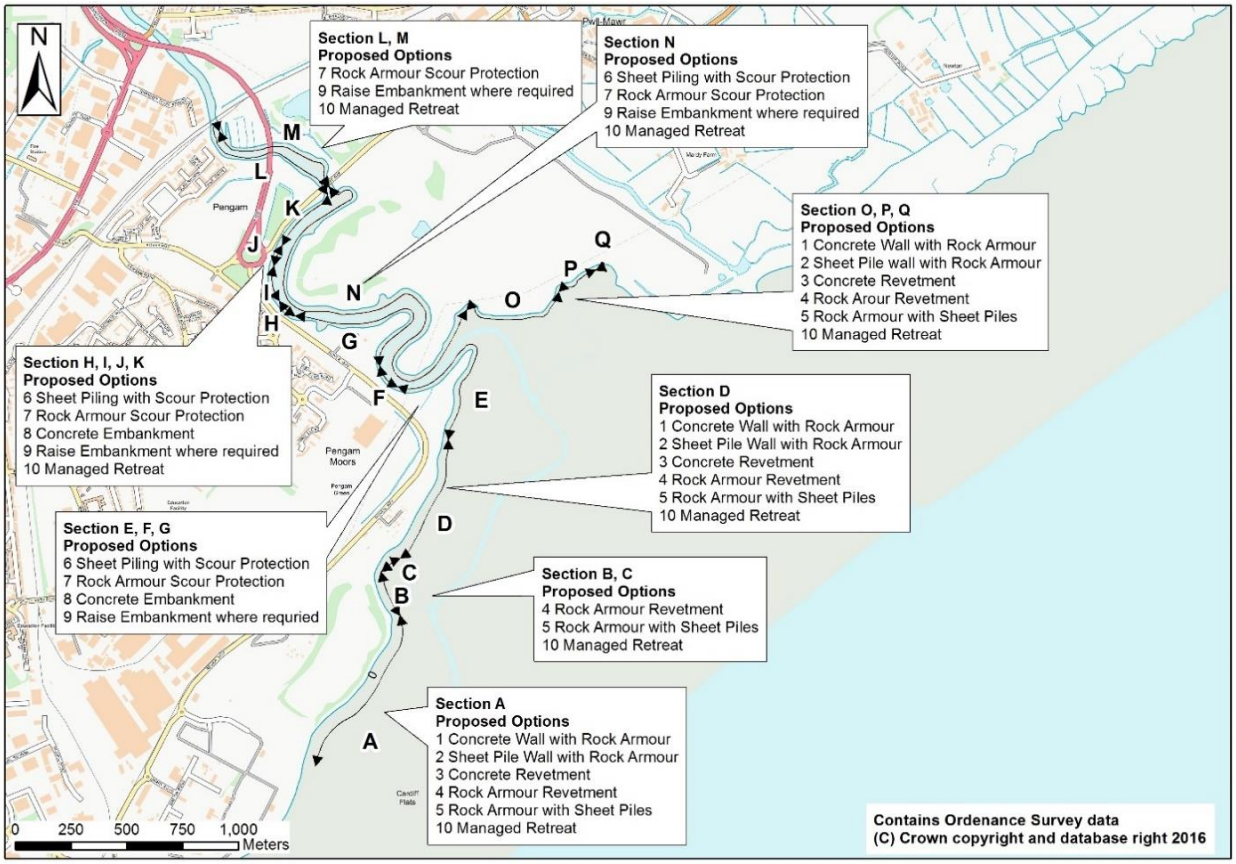


**Figure 2-2: Long list of options for each Asset Section**

**Table 2-2: Short-listed options**

| Option | Name | Description |
|---|---|---|
| 1 | Do Nothing | No works undertaken. Allow natural coastal and fluvial processes to continue. |
| 2 | Do Minimum | Maintenance works along existing earth embankments. Add small rock toe to the eroding coastal defences to slow erosion. |

[8] Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG), Environment Agency, 2010 (http://webarchive.nationalarchives.gov.uk/20131108051347/http:/a0768b4a8a31e106d8b050dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0310bsdb-e-e.pdf

| Option | Name | Description |
|---|---|---|
| 3 | Improve 1 | Rock revetment along the coast to manage erosion and wave overtopping Rock scour protection along Lamby Way roundabout Maintain earth embankments elsewhere and raise low points in earth embankments where required to reduce flood risk. Scour protection added to Lamby Way Bridge. |
| 4 | Improve 2 | Sheet piling along the coast to manage erosion and wave overtopping. Rock scour protection along Lamby Way roundabout. Maintain earth embankments elsewhere and raise low points in earth embankments where required to reduce flood risk. Rock scour protection added to Lamby Way Bridge. |
| 5 | Improve 3 | Concrete wall along the coast to manage erosion and wave overtopping. Rock scour protection along Lamby Way roundabout. Maintain earth embankments elsewhere and raise low points in earth embankments where required to reduce flood risk. Rock scour protection added to Lamby Way Bridge. |
| 6 | Improve 4 | Rock revetment along the coast to manage erosion and wave overtopping. Sheet piling along Lamby Way roundabout. Maintain earth embankments elsewhere and raise low points in earth embankments where required to reduce flood risk. Rock scour protection added to Lamby Way Bridge. |
| 7 | Improve 5 | Sheet piling along the coast to manage erosion and wave overtopping. Sheet piling along Lamby Way roundabout. Maintain earth embankments elsewhere and raise low points in earth embankments where required to reduce flood risk. Rock scour protection added to Lamby Way Bridge. |
| 8 | Improve 6 | Concrete wall along the coast to manage erosion and wave overtopping. Sheet piling along Lamby Way roundabout. Maintain earth embankment elsewhere and raise low points in earth embankments where required to reduce flood risk. Rock scour protection added to Lamby Way Bridge. |

**Table 2-3: Multi Criteria Analysis categories and weighting**

| Category | Considerations | Weighting |
|---|---|---|
| **Technical** | Still water level flood protection | 2 |
| | Overtopping protection | 2 |
| | Design life | 1 |
| | Erosion protection | 2 |
| | Ease of construction | 1 |
| | Capital cost | 2 |
| | Maintenance cost | 2 |
| | Public Health and Safety | 2 |
| **Environmental and Social** | Impact on the coast path use | 2 |
| | Impact on biodiversity | 2 |
| | Impact on landscape character | 1 |
| | Impact on heritage | 1 |
| | Ability to be modified in the future | 1 |
| | Carbon footprint | 2 |
| | Impact on coastal processes | 1 |
| | Contaminated land protection | 2 |
| **Financial** | Partnership funding | 2 |
| **Strategic** | Strategic policy (SMPs) | 2 |
| | Consents and licences | 1 |

2.3.3 Stakeholder engagement was undertaken to inform the assessment process and the selection of a preferred option. Key responses received are summarised in Table 2-4.

**Table 2-4: Key stakeholder responses**

| Organisation | Interest | Response | Actions taken |
|---|---|---|---|
| RSPB | Wildlife conservation | The recommendations of the Living Levels Partnership should be considered so CCC can help meet its objectives. | These recommendations have been considered within the landscape appraisal to inform the preferred option. |
| NRW | Flood risk management/ wildlife conservation/ ground contamination/ water quality/public access | Further analysis of ground contamination should be undertaken for the Frag Tip (off Rover Way) to inform risk of contamination mobilisation and design requirements. Habitat Regulations Assessment required to assess effects on designations and requirement for habitat compensation. | Ground contamination investigation to be undertaken by CCC as a separate project. Results to inform flood defence scheme at detailed design stage. Habitat Regulations Screening Assessment undertaken at OBC stage. Further assessment required at detailed design stage. Consultation with NRW regarding compensation requirements is ongoing. |
| Cadw | Archaeology and cultural heritage | Particular attention should be given to the impacts of the project on the Rumney Great Wharf Relict Seawall (GM474). | This issue has been addressed in the archaeological desk based assessment (DBA), concluding only a low risk of an impact to the setting of the scheduled monument. |
| DCWW | Owner of adjacent defences to the west/ utilities assets | Undertaking separate assessment of DCWW defences. Would be interested in sharing information and potentially combining schemes to gain efficiencies. | Discussion with DCWW have continued and meetings are underway to discuss potential to combine scheme design and construction. |

## 2.4 Detailed design of the proposed development

2.4.1 The preferred option for the development will involve the construction of a new embankments, raising of existing embankments, installation of sheet piling, and installation of scour protection.

2.4.2 Several design options to deliver the preferred option have been developed. These have been informed by a range of site surveys and investigations and consultation with key stakeholders.

### Initial design development

2.4.3 The original Cardiff Coastal Defences OBC was completed in March 2017 and subsequently approved by Welsh Government in the same year. In December 2018, updated Welsh Government climate change guidance was released, increasing the predicted sea level rise for Cardiff by approximately 300mm over the 100-year appraisal period. Modelling of the OBC preferred option using this new climate change guidance showed that greater lengths and heights of defences would be necessary to achieve the required standard of protection of 1 in 200 years (0.5% AEP) in 2119 with the updated sea level rise allowances.

2.4.4 Several sections required additional defences as a result of the increased climate change allowances. Notably, new defences were required at Parc Tredelerch, Windsor Gardens in future years and greater lengths of raising were required towards the

southern extent of the estuary. Further to this, the rock revetment and embankment along the coast needed to be greater in height and scale. Notably, areas requiring higher fluvial defences span from Pengam Allotments, south to Pengam Green Tesco.

2.4.5 In addition to longer lengths of defence, results from a Ground Investigation survey identified limits on pile lengths able to be used as a result of the bed rock level. This led to the requirement for additional scour protection works be used in order to maintain the slope in front of the sheet pile, enabling a shorter pile to be used.

2.4.6 A number of physical landslips have occurred on this part of the river. The scheme extents were again increased to consider an erosion slip that occurred opposite the Cardiff Sailing Club, an area not considered for erosion defences at OBC. Most recently, a landslip occurred in the embankment at the edge of the Lamby Way Tip. This also led to additional erosion protection being required on the eastern bank of the Rhymney in the location of the meanders where erosion could risk failure of the landfill.

2.4.7 The OBC proposed design relied heavily on grey, high carbon engineering to alleviate flooding and erosion. As a result of the significant increase in scheme extent, and the increase in scour protection required, the potential environmental impacts of the scheme increased. To minimise environmental impacts, more nature-based solutions were investigated with the aim of maintaining as natural a channel as possible to support and maintain the existing habitat, whilst also managing erosion and flood risk. Rock armour continues to be proposed for the coastal sections of the scheme. However, a hybrid solution has been developed for the river channel. This proposed option has been presented and discussed with external stakeholders.

### Stakeholder engagement to inform the design process

2.4.8 A Stakeholder Engagement Plan (SEP) was developed to guide and record stakeholder engagement during the design process. The SEP followed the "Building Trust with Communities" guidance developed by the Environment Agency, which encourages the project team to engage with stakeholders early on to understand their concerns, interests, and priorities.

2.4.9 Each stakeholder has different levels of influence on the direction and outcomes of the scheme. Considerable focus was applied identifying and evaluating an appropriate approach to be adopted for engagement level.

2.4.10 Stakeholders were grouped and a range of engagement methods and approaches were assigned to each group to gain their input effectively. A variety of engagement methods were used including statutory consultation meetings, site visits, and meetings.

2.4.11 An environmental scoping letter was also produced, including a brief overview of the flood risk and coastal erosion alleviation project and the environmental and socio-economic context. This was delivered to provide information to stakeholders that may be interested in the project and facilitate a means of communication. A communications record for the consultations has been kept throughout the project, which includes records of meetings and other communications.

2.4.12 The Rhymney Boat Club has been consulted regarding their preferred option for maintaining access through the proposed embankment.

2.4.13 A screening and scoping report was submitted to the Marine Licence team at NRW and CCC. Prior to gaining a response, a consultation meeting was conducted on the 25th March 2021 with CCC and NRW to go over the changes to the scheme and gain an

understanding of any concerns or issues with the proposed scheme. Follow up meetings with NRW were arranged for the 30th April 2021 and the 12th May 2021 regarding sediment transport and coastal squeeze.

2.4.14 On the 19th May 2021 two more consultation meetings were undertaken. One with Welsh Government about the scheme and the other with CC and NRW regarding the Wales Coast Path.

2.4.15 Further stakeholder engagement is planned for the Pre-Application Consultation stage of the planning application for this scheme.

2.4.16 Consultation undertaken with key stakeholders within this project helped inform the scope of environmental issues and assessment, and to inform the option selection and development.

### Detailed design of the preferred option

2.4.17 Based on the results of the MCA and other technical, financial, and environmental assessment work, an overall preferred option for each section of the study area was determined. Due to the scale of the proposed development (approximately 6km section of coastline/river frontage), different options were preferred for different areas. This combination of options was derived from Option 6 (Improve 4) and is illustrated in Figure 3-3. The preferred options are:

2.4.18 ***Section 1a/Locations 11 & 12: Severn Estuary coastline east and west of the confluence with the Rhymney River*** – the proposal along this section, extending either side of the Rhymney River, is to construct a sloping rock armour revetment along the coastline to manage coastal erosion of the Frag Tip, Lamby Way Landfill, and adjacent areas (including the Wales Coast Path), and tidal flood risk to infrastructure (Rover Way, Wales Coast Path) and residential and commercial properties from wave overtopping.

2.4.19 ***Section 1b/Location 12: Severn Estuary coastline west of the confluence with the Rhymney River*** – the proposal along this section is to construct a sloping rock armour revetment along the coastline to manage coastal erosion of the Frag Tip and adjacent areas (including the Wales Coast Path), and tidal flood risk to infrastructure (Rover Way, electricity transmission, Wales Coast Path) and residential and commercial properties from wave overtopping.

2.4.20 ***Section 2a/Location 22: Segment of the west bank of the Rhymney River from its confluence with the Severn Estuary northwards to the southern approach to the Rover Way/A4232/Lamby Way roundabout*** – the proposal in this section is to raise the existing earth embankment to the required flood defence level. The existing embankment top level varies along the section, meaning the height of the raising works varies accordingly to achieve a uniform crest level. A double flood gate will also be installed at the entrance to the Rhymney River Motor Boat, Sail & Angling Club off Rover Way to provide flood protection.

2.4.21 ***Section 2b/Locations 42 & 52: West bank of the Rhymney River from the Lamby Way road bridge, northwards to Page Drive*** - the proposals comprise construction of new earth embankments on the line of the existing embankment flood defences, between the Lamby Way road bridge and the A4232 road bridge, and between the A4232 road bridge and the southern boundary of the Page Drive residential estate. Both sections of embankment are setback from the river channel.

2.4.22 Section 3a/Location 32: West bank of the Rhymney River, from the southern approach of Rover Way up to Rover Way/A4232/Lamby Way roundabout – the proposals comprise construction of concrete erosion protection mats adjacent to Rover Way and Lamby Way to provide flood defence and scour protection. The toe of these mats will be buried into the riverbed below the low water line and secured by backfilling with rock armour units.

2.4.23 ***Section 3b/Location 32: West bank of the Rhymney River, from the Rover Way/A4232/Lamby Way roundabout, northwards to the Lamby Way road bridge*** – the proposals comprise construction of new sheet piles to flood defences to the section of natural riverbank alongside Lamby Way.

2.4.24 ***Section 4/Locations 21 & 31: Segments of the East bank of the River Rhymney at the Lamby Way road bridge and the large meander opposite the Rhymney River boat club*** – the proposals comprise construction of erosion protection mats to provide erosion and scour protection to the riverbank adjacent to the Lamby Way landfill site.

2.4.25 ***Section 5/Location 22: Segment of the west bank of the Rhymney River at the meander adjacent to Rover Way*** - the proposals comprise construction of new sheet piles complete with concrete capping beam at the river meander adjacent to Rover Way. This design will provide enhanced erosion protection where there is restricted space between Rover Way and the river.

**Table 2-5: Summary of Proposed defence section names and location number(s)**

| Section Name | Location Number(s) |
|---|---|
| 1a | 11 & 12 |
| 1b | 12 |
| 2a | 22 |
| 2b | 42 & 52 |
| 3a | 32 |
| 3b | 32 |
| 4 | 21 & 31 |
| 5 | 22 |

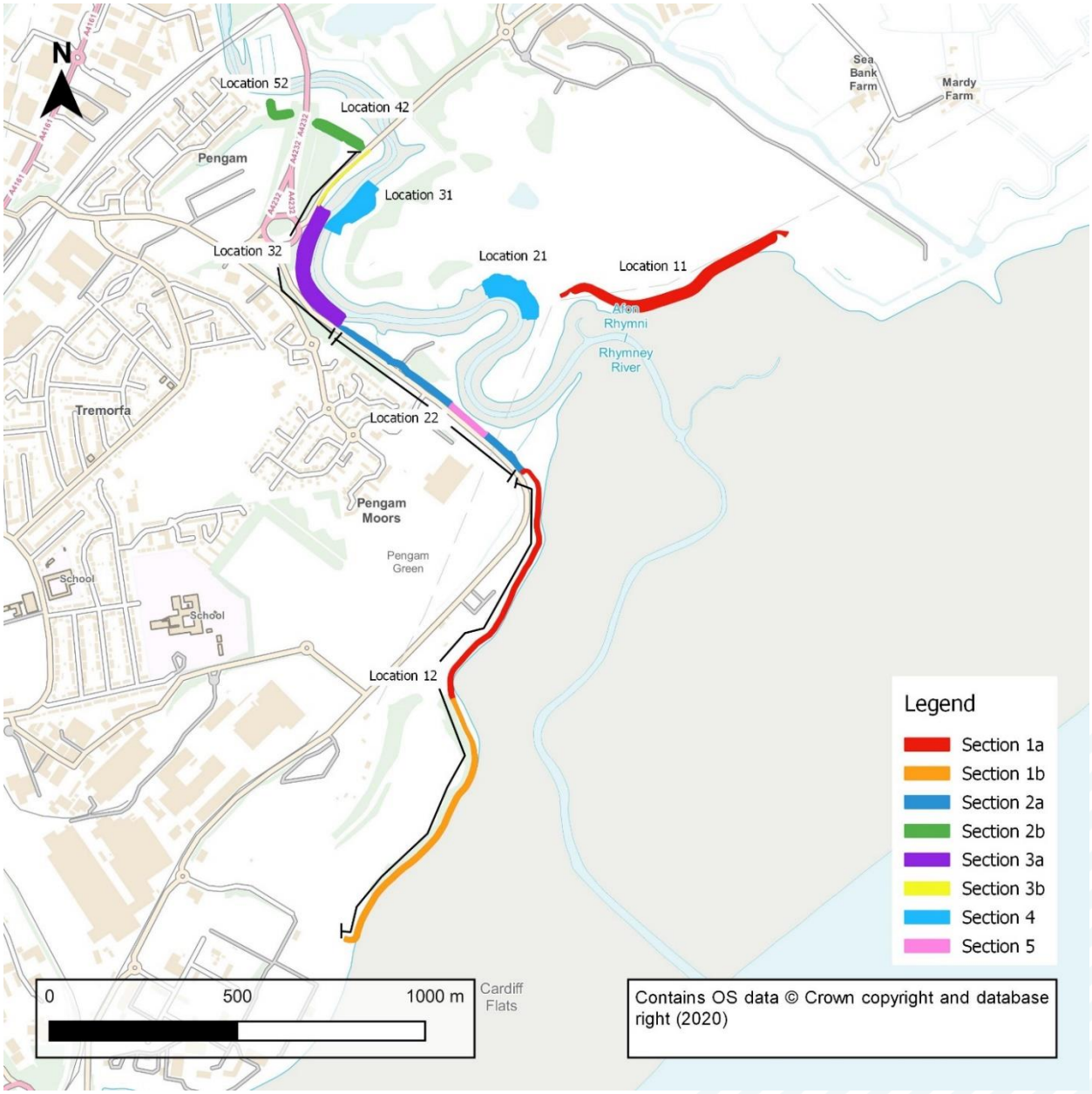


**Figure 2-3: Preferred options for each scheme section**

### Description of the proposed development

2.4.26 A detailed description of the design proposals for each section is provided below.

***Section 1a/Locations 11 & 12: Severn Estuary coastline east and west of the confluence with the Rhymney River***

2.4.27 This section extends along much of the coastal reach of the Severn Estuary within the scheme area. The frontage includes the entire eastern coastal reach and approximately half the western reach. These areas are generally natural coastline, although there is a short length of existing defence. It includes the coastal frontage of the Lamby Way Landfill, which is at risk of erosion in the near future. Along both

sections of estuary frontage are the remnants of historic flood defence structures, including sections of severely damaged gabion baskets adjacent to the Frag Tip and the remains of a rock armour revetment along much of the frontage next to the Lamby Way Landfill. The Wales Coast Path extends along this coastal section and is immediately adjacent to the foreshore for much of the extent. Land use in this area includes a Traveller's static residential site.

2.4.28 The design cross-section includes a rock armour revetment on the foreshore area with an (imported) clay bund behind. To the east of the Rhymney, the bund is at approximately the same level of the existing ground, with rising levels behind. To the west of the Rhymney, the bund is at a higher level than existing, approximately 500mm above the rock crest. The bund will be covered in seeded topsoil and will double as pedestrian access.

2.4.29 To construct the rock revetment, earthworks will be required to shape formation level. As part of this, some granular fill material import will be required. Additionally, various geotextiles and a turf reinforcement mat are included in the structure build-up.

***Section 1b/Location 12: Severn Estuary coastline west of the confluence with the Rhymney River***

2.4.30 This section extends along the coastal reach of the Severn Estuary within the scheme area. The frontage is in front of the old frag tip on the western coastal reach. This area is generally a natural coastline, although there is exposed manmade materials on the shallow cliff behind the beach. This ground is being steadily eroded into the Severn estuary. Land use in this area includes a derelict area used as a dirt bike track but with planning approval for a biomass energy plant, and a main electricity sub-station. The DCWW Cardiff East Waste Water Treatment Works and Tremorfa Industrial Estate are located immediately west of this section.

2.4.31 The design cross-section includes a rock armour revetment set forward on the foreshore area with an (imported) fill material slope behind. The slope behind the new rock revetment slackens the existing slope and ties into existing ground levels with a termination detail. Earthworks will be required to construct both the rock armour and slope behind, requiring granular fill material import. Additionally, various geotextiles and a turf reinforcement mat are included in the structure build-up.

***Section 2a/Location 22: Segment of the west bank of the Rhymney River from its confluence with the Severn Estuary northwards to the southern approach to the Rover Way/A4232/Lamby Way roundabout***

2.4.32 This section generally comprises an existing earth bund that is located between Rover Way and the Rhymney River channel and extends northward to the Rover Way/A4232/Lamby Way roundabout. It includes a length of existing steel sheet piles and erosion protection measures in the riverbank on the riverside of the earth embankment, adjacent to the large meander. The embankment and sheet piles provide flood and erosion protection for Rover Way, which is immediately landward, as well as utilities (electricity and water) services, and serves as the primary flood defence for nearby residential areas in Pengam Green and Tremorfa. The Wales Coast Path is located on the crest of the existing embankment. The river channel in this area contains extensive areas of inter-tidal mudflat and saltmarsh habitat, which provide very important feeding and high-tide roosting habitat for SPA/Ramsar bird species. The large areas of saltmarsh adjacent to the large river meander in this area are particularly

important as high-tide roosts for significant numbers of birds.

2.4.33 The proposed defence raises the existing bund (where present) to the required level, continuing the existing bund slope face adjacent to Rover Way up to the new crest level. The flood defence will be achieved using imported clay fill with a seeded topsoil finish. The crest of the embankment will provide pedestrian access alongside the Rhymney.

2.4.34 The frontage includes a double flood gate installed within a concrete housing structure to provide access to the Rhymney River Motor Boat Sail & Angling Club.

***Section 2b/Locations 42 & 52: West bank of the Rhymney River from the Lamby Way road bridge, northwards to Page Drive***

2.4.35 Section 2b extends along the west bank of the Rhymney River between Lamby Way road bridge and the southern boundary of Page Drive. The defence currently consists of two sections of earth embankment set back from the river bank, and in places, the embankment is lower than the 2117 200-year still water level.

2.4.36 The proposed defence raises the existing bund (where present) to the required level, generally following the centreline of the existing defence. The flood defence will be achieved using imported clay fill with a seeded topsoil finish.

***Section 3a/Location 32: West bank of the Rhymney River, from the southern approach of Rover Way up to Rover Way/A4232/Lamby Way roundabout.***

2.4.37 This section is generally a natural riverbank alongside the Rover Way and Lamby Way although there are some old sheet piles present. There are signs of active erosion, and the sheet piles are at the end of their service life. This erosion is threatening roundabout and adjacent sections of Rover Way and Lamby Way, which are critical transport routes connecting Cardiff city centre and eastern areas of the city.

2.4.38 The design proposes that concrete erosion protection mats are installed on the riverbank. The toe of these mats will be buried into the riverbed below the low water line and secured by backfilling with rock armour units. On the lower portion of the bank, the mats will be exposed on the surface of the bank as required to manage scour action. The design proposes that at a suitable level, the erosion mats cut back into the bank and continue up under a depth of natural mud material. The risk of erosion of this mud layer is reduced, but over the service life there is the possibility that the erosion protection beneath may become exposed. At the transition point between buried and exposed erosion mats, wooden stakes and brushwood is proposed to help retain mud and facilitate establishment of the mud layer.

2.4.39 At the top of the bank, a sheet piled flood defence is proposed completed with concrete capping beam. This will be provided to the flood defence level.

***Section 3b/Location 32: West bank of the Rhymney River, from the Rover Way/A4232/Lamby Way roundabout, northwards to the Lamby Way road bridge***

2.4.40 This section is generally a natural riverbank alongside Lamby Way and the Lamby Way road bridge. There are signs that this area is currently accreting and so no erosion protection is proposed. At the top of the bank, a sheet piled flood defence is proposed

completed with concrete capping beam.

***Section 4/Locations 21 & 31: Segments of the East bank of the River Rhymney at the Lamby Way road bridge and the large meander opposite the Rhymney River boat club***

2.4.41 This section is generally a natural riverbank adjacent to the historic Lamby Way landfill. There are signs of active erosion, with a significant bank slip occurring directly opposite the roundabout. This slip was repaired by Cardiff Council in 2018 but was subject to further failure in February 2020.

2.4.42 The design proposes that concrete erosion protection mats are installed on the riverbank. The toe of these mats will be buried into the riverbed below the low water line and secured by backfilling with rock armour units. On the lower portion of the bank, the mats will be exposed on the surface of the bank as required to manage scour action. The design proposes that at a suitable level, the erosion mats cut back into the bank and continue up under a depth of natural mud material. The risk of erosion of this mud layer is reduced, but over the service life there is the possibility that the erosion protection beneath may become exposed. At the transition point between buried and exposed erosion mats, wooden stakes and brushwood is proposed to facilitate establishment of the mud layer.

***Section 5/Location 22: Segment of the west bank of the Rhymney River at the meander adjacent to Rover Way.***

2.4.43 This section comprises an existing earth bund that is located between Rover Way and the Rhymney River channel. The proposed defence is a steel sheet pile wall complete with concrete capping beam. The sheet pile provides more resilience to erosion than a flood embankment in this location due to the restricted space between the highway and river channel.

## 2.5 Outline construction methodology

### Construction access

2.5.1 Access for all vehicle types to the west of Rhymney River will be via Rover Way initially and then via an existing access point onto the Frag Tip/motocross track to the west of the Traveller site.

2.5.2 Access to the east of Rhymney River will be off Lamby Way onto the existing vehicular entrance to Lamby Way Landfill. The construction vehicles will then access the river sections and Severn Estuary coastline via an existing vehicular access track across the landfill.

2.5.3 To access the construction areas north of the Lamby Way road bridge, vehicles will enter via a new access created off Lamby Way or turn off Rover Way via an existing vehicular through the Stargarallot Community Garden (Pengham allotments).

2.5.4 Most construction materials i.e., sheet piles, earth, etc, will be brought to the construction site via the existing highway network (primarily via Rover Way from Cardiff Docks). Rock may potentially be brought to the site by road or by barge via the Severn Estuary foreshore.

***Location 11***


**Figure 2-4: Site access to Locations 11, 21 and 31**

2.5.5 Access to Location 11 is shown in figure 2-4. The main site access to this area would be through the Household Waste Recycling Centre located directly off the Lamby Way Site roundabout. This would provide the main artery to the works with an option to provide secondary access routes to the works in section 4. This would also be the ideal location for a secondary Site Set-up the exact location of which would be subject to agreement of availability of land with HWRC.

***Location 12***


**Figure 2-5: Site access to locations 12 and 22**

2.5.6 Access to Location 12 is shown in figure 2-5.

***Access 12.1***

2.5.7 There appears to be an existing layby on the southern side of Rover Way, approximately 100m north of Seawall Road, providing access to the Frag Tip. This would provide the Main Site Entrance as well as access to the centre of the works at section 1b. The main site compound may be set up at this location or one of the storage locations. There is also sufficient space along the length of this section to set up two blockstone stockpile areas.

***Access 12.2***

2.5.8 The existing gate at the seaward end of Tide Fields Road would allow access to the southern end of the works at this section. This route provides an existing tarmac road, and a gate enabling control of deliveries. Access would be through an operational industrial estate.

***Access 12.3***

2.5.9 It is proposed to create a site entrance directly off Rover Way as it curves inland at a convenient location subject to sight lines. This entrance would provide direct access to the northernmost end of the works at section 1a, as well as providing access to the southern end of section 2a.

***Locations 21 & 31***

2.5.10 Access to Locations 21 and 31 are shown in figure 2-4. The access to Location 11 would

provide the main route into the area and then a secondary access road will be set up westwards along an agreed line to locations 21 and 31. This access route runs over a long slope of soft material and therefore would require stabilisation for plant access. This could be achieved by placing rock into the soft material bed to provide a working platform. Alternatively, bearing piles could be used or low ground pressure excavators.

***Location 22***


**Figure 2-6: Site access to locations 22 and 32**

2.5.11 Three separate access points are proposed for this section. These are shown in Figure 2-6. Access via these routes could be achieved without the need for traffic control measures along Rover Way.

***Access 22.1***

2.5.12 This access point would utilise the lane leading from Rover Way to the Rhymney River Motor Boat Sail and Angling Club, with access to the east and west of this lane. We propose that it would be the main point of access for the works at Location 22, providing that permission is obtained from the Club.

***Access 22.2***

2.5.13 Access off Rover Way as it curves inland. This access point would be shared with Location 12.

***Access 22.3***

2.5.14 Access would be created off Rover Way at the western end of the section and would also provide access to the eastern end of location 32.

***Location 32***


**Figure 2-7: Site access to locations 32, 42 and 52**

2.5.15 It is proposed to create access points at both ends of this section. These are shown in figures 2-6 and 2-7.

2.5.16 The southern access would be provided from access point 22.3

2.5.17 Northern access will be created directly off Lamby Way, immediately before the road bridge.

2.5.18 To enable certain works at Location 32, namely sheet piling adjacent to the A4232/Lamby Way/Rover Way roundabout, sufficient room is needed to create a safe working zone/segregation area between the works and live traffic. This would be

achieved by reducing the width of the central roundabout island and installing a temporary running surface to accommodate single width traffic. This may also involve taking up a section of the western verge of Lamby Way to provide a temporary running surface to move the north bound traffic, providing more traffic space. This would enable two lane traffic to be maintained throughout the construction period. This solution is possible as long as the temporary surface is no narrower than 3m wide in order to accommodate HGVs.

2.5.19 A detailed construction traffic management plan will be prepared in order to confirm the approach.

***Location 42 & 52***

2.5.20 Access to locations 42 and 52 is shown in figure 2-7. It is proposed to gain access to locations 42 and 52 directly off the western side of Lamby Way, as close as possible to the river bridge – or alternatively through the allotment access road. A temporary haul road will be constructed northwards along the riverbank to access the northerly end of the works at this section. This haul road would extend underneath the A4232 and will therefore be subject to height restrictions.

### Construction Traffic Management

2.5.21 To enable certain works at Location 32, namely sheet piling adjacent to the A4232/Lamby Way/Rover Way roundabout, sufficient room would need to be provided such in order to create a safe working zone/segregation area between the works and live traffic. This would be achieved by reducing the width of the central roundabout island and installing a temporary running surface to accommodate single width traffic. This may also involve taking up a section of the western verge of Lamby Way to provide a temporary running surface to move the north bound traffic, providing more traffic space. This would enable two lane traffic to be maintained throughout the construction period. This solution is possible as long as the temporary surface is no narrower than 3m wide in order to accommodate HGVs.

2.5.22 A detailed traffic management plan will be required in order to confirm this approach.

### Construction materials

2.5.23 A schedule of construction materials and approximate volumes/quantities to be used to construct the proposed development is provided in Table 2-6.

**Table 2-6: Schedule of construction materials**

| Ref. | Description | Quantity | Unit |
|---|---|---|---|
| 1 | Geotextile | 72301 | m2 |
| 2 | Geocell | 18501 | m2 |
| 3 | Embankment Fill Material | 49570 | m3 |
| 4 | Topsoil | 5286 | m3 |
| 5 | Rock Armour | 54400 | m3 |
| 6 | Reno Mattress/other scour protection | 21374 | m2 |
| 7 | Brushwood | 12062 | m2 |
| 8 | 6m long SSP | 717 | lm |
| 9 | 15m long SSP | 999 | lm |
| 10 | RC Capping Beam | 523 | m3 |

### Construction plant

2.5.24 A schedule of the construction machinery/plant likely to be used to construct the proposed development is provided in Table 2-7.

**Table 2-7: Schedule of construction machinery/plant**

| Machinery/plant | Description |
|---|---|
| 35/ 45 tonne long reach excavator | Exact size would be subject to the final design / methodology; an access road / working area would be prepared at a convenient location, such as top of the embankment, and then a long reach excavator would be used to excavate / place the blockstone and rock armour |
| 28 – 35 tonne tracked Excavators | These will be used for general excavation works<br>• forming access tracks<br>• construction of embankments |
| Dump-trucks | Will be used to<br>• transport excavated material to stockpile for disposal<br>• transport rock armour/ blockstone from stockpile to work place |
| Sheet pile Leada rig (alternative) | This may be employed to install the longer 15m sheet piles along the roadside – although this will be subject to ground investigation which will inform the driving conditions |
| Marine Plant:<br>• Work boat<br>• Safety Boat<br>• Floating pontoons | May be needed to provide safe working access at tidal level |

### Construction site boundary

2.5.25 The construction site boundary for the proposed development is shown in Figure 2-4. This includes the footprint of the permanent works, the areas needed to accommodate construction compounds and storage facilities, and the construction access routes from the public highway to be used to facilitate access for construction plant, vehicles and staff.

2.5.26 The total area contained within the site boundary extends to approximately 40ha.

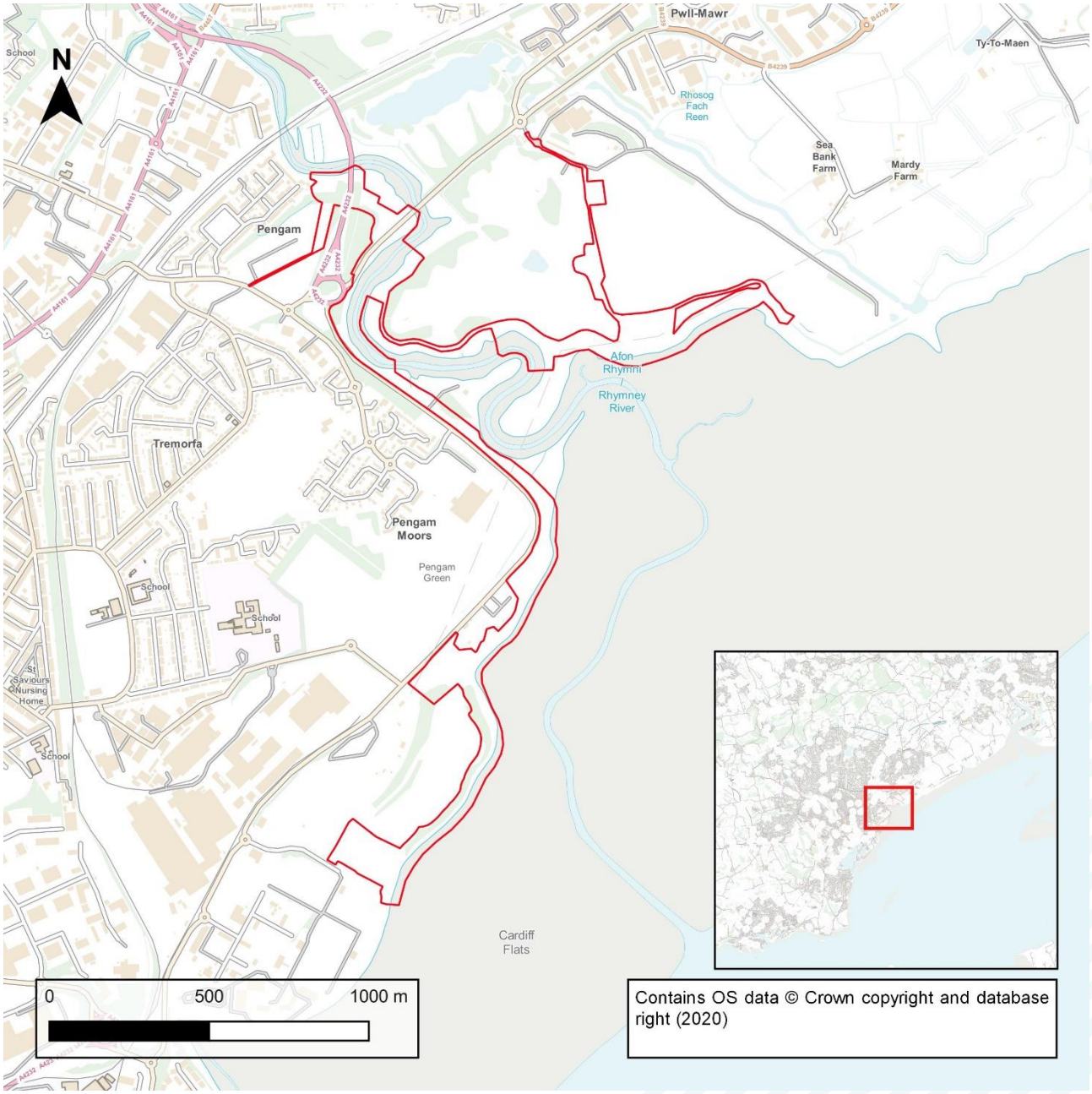


**Figure 2-8: Proposed construction site boundary.**

### Construction method

2.5.27 The following section provides a high-level construction methodology.

***Location 11***

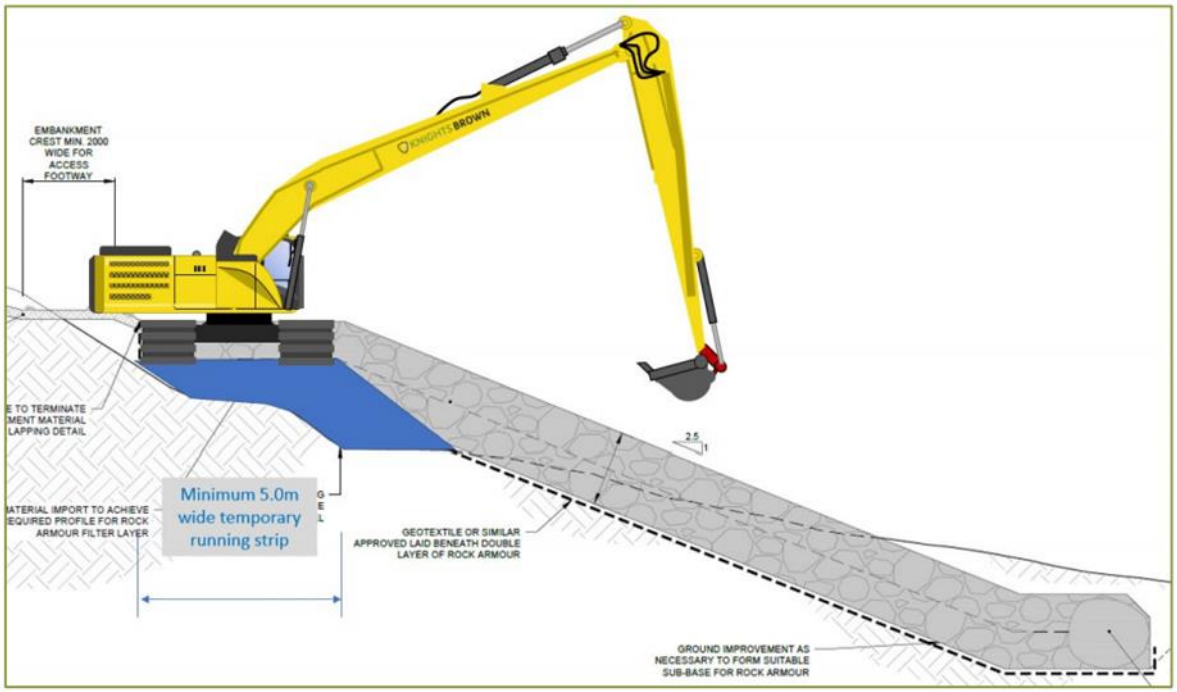


**Figure 2-9: Construction methodology for location 11**

2.5.28 The proposed construction sequence would mirror that for section 1a (western extent) and section 1b above as follows:

1. Stockpile rock armour
2. Carry out initial excavation to form the crest
3. Install geotextile and sufficient depth of stone along the length of the crest to provide a running surface / access track for plant.
4. This will be constructed in line with permanent construction specification, but used as temporary access platform.
5. Most imported stone will be reused within the permanent works.
6. Construct embankment using long reach excavator situated on crest.
7. Complete crest construction
8. Install / tie in topsoil

2.5.29 This methodology may have to be amended in this section due to the presence of overhead national grid cables. Working restrictions may have to be imposed on the long reach excavator, including fitting restrictors to the excavator arm or utilising a smaller machine. Consultation with the National Grid will be required to agree the methodology prior to commencement of the works.

***Location 12***

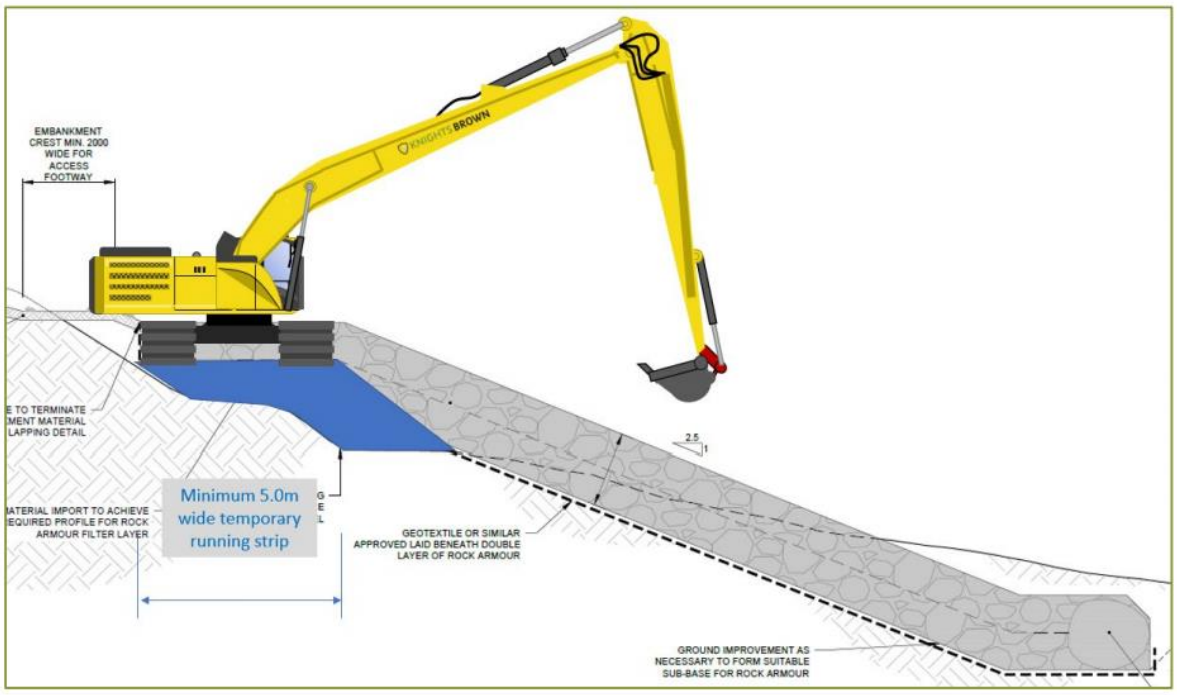


**Figure 2-10: Construction methodology for location 12**

2.5.30 For these sections, the critical access path will be dictated by the supply of blockstone. Significant pre-construction works may be required in these locations. Stabilisation of the cliff line along the old frag tip may be required prior to the main works in order to allow plant movement. The basic sequence of works will be to install a temporary access track into the works up to approximate midpoint between access points and then to construct the permanent works on the way out.

2.5.31 The proposed construction sequence would be:

1. Stockpile rock armour
2. Carry out initial excavation to form the crest
3. Install geotextile and sufficient depth of stone along the length crest to provide a running surface / access track for plant movement. This will be constructed in line with permanent construction specification, but used as temporary access platform. Therefore most of the temporary imported stone will be reused within the permanent works.
6. Construct embankment using long reach excavator situated on crest.
7. Complete crest construction
8. Install embankment fill / topsoil.

***Locations 21 & 31***

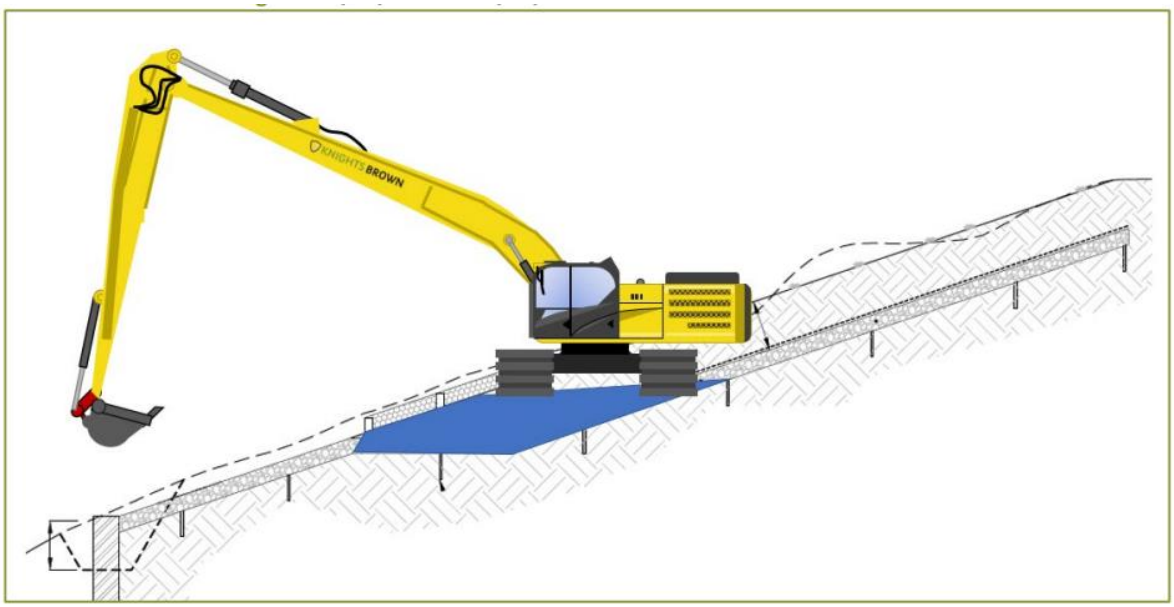


**Figure 2-11: Construction methodology for locations 21 and 31**

2.5.32 The high-level construction sequence would be as follows, this applies equally to both Locations 21 and 31 (note sketch above shows pile and trench option for securing the toe of the scour protection – a trench filled with rock armour is proposed):

1. Carry out initial excavation to provide access to mid platform level
2. Install geotextile and sufficient temporary stone along the width of this section to provide a running surface / access track for plant movement
3. Install scour protection from line of piles to mid-level platform.
4. Complete installation of scour protection. This will involve creating a trench which buries the toe of the scour protection. Ideally bulk bags will be utilised as a dewatering method, however this would be dependant on gaining access from the land side. Alternatively, working from the water may be required.
5. Construct embankment fill in over scour protection.
6. Install timber stakes and brushwood on upper slope.

***Location 22***

2.5.33 The high-level construction sequence would be:

1. Carry out initial excavation to form benches
2. Install geotextile and sufficient depth of stone along the width of the embankment to provide a running surface / access track for plant movement. This would be carried out using the absolute minimum thickness of stone to provide a stable running surface, and that it could remain in place permanently, with cohesive material placed on top. Alternatively, the stone could be removed on the way out and replaced with the cohesive material.
3. Construct embankment fill in layers.
4. Complete topsoil

***Location 32***

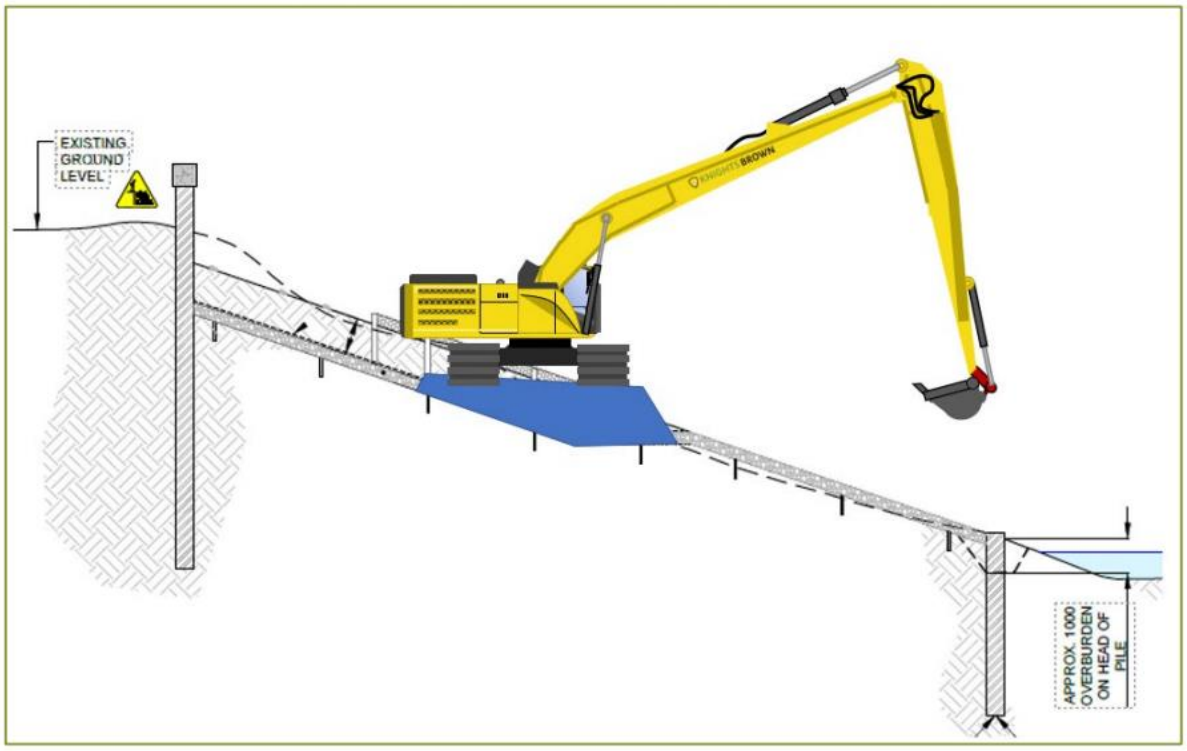


**Figure 2-12: Construction methodology for location 32 (note toe piles no longer proposed within the channel but a rock trench)**

2.5.34 The high-level construction sequence would be:

1. Carry out initial excavation to provide access to mid platform level
2. Install geotextile and sufficient temporary stone along the width of this section to provide a running surface / access track for plant movement
3. Install sheet piles along line of top of embankment – adjacent to highway
4. Complete excavation and Install scour protection from line of piles to mid-level platform.
5. Complete installation of scour protection. This will involve creating a trench which buries the toe of the scour protection. Working from the water may be required.
6. Replace mud material fill over scour protection.
7. Install timber stakes and brushwood.

***Locations 42 & 52***

2.5.35 Works to these areas are likely to be carried out concurrently since a single point of access off Lamby Way is proposed. The permanent works of Location 42 would provide access to Location 52.

2.5.36 Complete work at Location 52 and then complete the works working back towards Lamby Way.

1. Location 42 - Carry out initial excavation to form benches
2. Install geotextile and sufficient depth of stone along the width of the embankment to provide a running surface / access track for plant movement. This would be carried out using the absolute minimum thickness of stone to provide a stable running surface, and that it could

remain in place permanently, with cohesive material placed on top. Alternatively, the stone could be removed on the way out and replaced with the cohesive material.

3. This will be required to provide access through Location 42 towards Location 52. In addition, we will extend the temporary access underneath the A4232 to Location 52.

4. Location 52 - Carry out initial excavation to provide access

5. Install geotextile and sufficient temporary stone along the width of this section to provide a running surface / piling platform.

6. Install sheet piles along line of top of embankment

7. Complete excavation and install scour protection.

8. Install timber stakes and brushwood

9. Location 52 / 42 - Construct embankment fill in layers.

10. Complete topsoil

### Construction programme

2.5.37 An outline construction programme can be found in table 2-8.

**Table 2-8: Outline construction methodology**

| Name | Start Date | Finish Date |
|---|---|---|
| Location 12 | March 2022 | April 2023 |
| Location 22 | May 2022 | January 2023 |
| Location 32 | September 2022 | August 2023 |
| Location 11 | December 2022 | August 2023 |
| Location 21 | February 2023 | August 2023 |
| Location 31 | March 2023 | November 2023 |
| Location 52 | December 2022 | April 2023 |
| Location 42 | November 2021 | June 2022 |

## 2.6 Operational requirements and decommissioning

2.6.1 Maintenance of the new flood defence structures is anticipated to include the following activities:

- Monthly visual inspection for any defects and/or signs of seepage.
- Frequent mowing of the grassed earth embankments keep grass cover short.
- Vegetation management to prevent the establishment of large woody shrubs and trees on the new embankment structures or immediately adjacent to the flood walls.
- Periodic clearance of large debris from the rock revetment and river scour protection as necessary.

## 2.7 Planning policy context

2.7.1 This section provides a summary of key planning policy context, highlighting where the proposed development accords with, or potentially conflicts with, specific policy requirements.

### Welsh National Marine Plan

2.7.2 The Welsh Government published the Welsh National Marine Plan9 in November 2019. This plan is directly informed by High Level Marine Objectives set out in the Marine Policy Statement (2011)10. These objectives align with the Welsh Government's Well-being Goals and principles for sustainable development and the direction provided in the EU Directive on Marine Spatial Planning 89/2014.

2.7.3 The plan objectives, relating to supporting policy objectives (i.e., in the Marine Policy Statement), of particular relevance to the scheme include:

- Plan Objective 7: Support enjoyment and stewardship of our coasts and seas and their resources by encouraging equitable and safe access to a resilient marine environment, whilst protecting and promoting valuable landscapes, seascapes and historic assets.
- Plan Objective 8: Improve understanding and enable action supporting climate change adaptation and mitigation.
- Plan Objective 9: Support the achievement and maintenance of Good Environmental Status and Good Ecological Status.
- Plan Objective 10: Protect, conserve, restore and enhance marine biodiversity to halt and reverse its decline including supporting the development and functioning of a well-managed and ecologically coherent network of Marine Protected Areas (MPAs) and resilient populations of representative, rare and vulnerable species.
- Plan Objective 11: Maintain and enhance the resilience of marine ecosystems and the benefits they provide in order to meet the needs of present and future generations.

### Shoreline Management Plan

2.7.4 The Severn Estuary Shoreline Management Plan 2 (SMP2)11 covers the Severn Estuary Coastline from Anchor Head to Lavernock Point. The policy for this SMP is 'Hold the Line' over the next three defined epochs (0-20 years, 20-50 year, 50-100 years). The SMP states this policy is required as further erosion into Lamby Way Industrial Site could be harmful to water quality, and the flood defences are also currently protecting important transport links.

### National Strategy for Flood and Coastal Erosion Risk Management in Wales

2.7.5 Under the Flood and Water Management Act 2010 the Welsh Government was required to develop the National Strategy for Flood and Coastal Erosion Risk Management in

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[9] Welsh Government, 2019. The Welsh National Marine Plan. [Online] Available at: https://gov.wales/marine-planning#section-29566

[10] National Assembly for Wales, 2011. Marine Policy Statement. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf

[11] Severn Estuary SMP2. [Online] Available at: https://www.slideshare.net/SevernEstuary1/smp2-part-b-policy-statements-cardiff-onlyfinal

[13] Welsh Government, 2011. National Strategy for Flood and Coastal Erosion Risk Management in Wales.

Wales13. The Strategy sets out a framework to help communities, the public sector and other organisations work together to manage flood and coastal erosion risk. It supports local decision-making and engagement in flood and coastal erosion risk management, making sure that risks are managed in a co-ordinated way across Wales. This includes the development of Local Flood Risk Management Strategies by Local Flood Authorities.

2.7.6 The National Strategy sets out four main objectives for managing flood and coastal erosion risk:

- Reducing the consequences for individuals, communities, businesses and the environment from flooding and coastal erosion;
- Raising awareness of and engaging people in flood and coastal erosion risk;
- Providing an effective and sustained response to flood and coastal events; and
- Prioritising investment in the most at-risk communities.

### Environment (Wales) Act 2016

2.7.7 The Environment Act requires (under Schedule 6 (1) and 6 (2)) public bodies to maintain and enhance biodiversity to promote the resilience of ecosystems (Welsh Gov., 2016). In complying with this, five key considerations must be undertaken (Welsh Gov., 2016):

- Diversity;
- Connectivity;
- Scale / extent;
- Condition; and
- Adaptability.

2.7.8 The State of Natural Resources Report, the National Natural Resources Policy 2017, and Area Statements will help decision-making take into consideration the sustainable management of natural resources.

### Cardiff Local Flood Risk Management Strategy

2.7.9 Cardiff Council has a duty placed on them by the Flood and Water Management Act (FWMA) to act as the Lead Local Flood Authority (LLFA) and prepare a Local Flood Risk Management Strategy (LFRMS)12. The strategy outlines Cardiff Council's responsibilities as a LLFA, and the roles and responsibilities of other organisations who are responsible for managing flood risk in Cardiff.

2.7.10 The LFRMS has identified four main strategy objectives:

- reducing the impacts on individuals, communities, businesses and the environment from flooding and coastal erosion;
- raising awareness of and engaging people in the response to flood and coastal risk;
- providing an effective and sustained response to flood and coastal erosion events; and
- Prioritising investment in the most at-risk communities.

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[12] Cardiff Council, 2014. Local Flood Risk Management Strategy, Adopted Strategy – Technical Document. [Online] Available at: https://www.cardiff.gov.uk/ENG/Your-Council/Strategies-plans-and-policies/Local-flood-risk-management-strategy/Pages/default.aspx

2.7.11 These objectives seek to achieve a number of outcomes, including:

- ensure a clear understanding of the local risks of flooding and erosion, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decision about the management of the residual risk;
- encourage innovative management of flood and coastal erosion risks, taking account of the needs of communities and the environment;
- form links between the local flood risk management strategy and local spatial planning;
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond properly to flood warnings;
- help communities to recover more quickly and effectively after incidents.

The LFRMS also defines a number of priorities actions that need to managed by Cardiff Council.

### Planning Policy Wales

2.7.12 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It translates the Welsh Government's commitment to sustainable development into the planning system, so that it can plan an appropriate role in moving towards sustainability13. The primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation.

2.7.13 The Well-being of Future Generations (Wales) Act (WBFGA) 2015 establishes a 'sustainable development principle' which means that a defined public body must act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs. In order to achieve this principle Welsh Government expects all those involved in the planning system to adhere to:

- putting people, and their quality of life now and in the future, at the centre of decision-making;
- engagement and involvement, ensuring that everyone has the chance to obtain information, see how decisions are made and take part in decision-making;
- taking a long-term perspective to safeguard the interests of future generations, whilst at the same time meeting needs of people today;
- respect for environmental limits, so that resources are not irrecoverably depleted or the environment irreversibly damaged. This means, for example, mitigating climate change, protecting and enhancing biodiversity, minimising harmful emissions, and promoting sustainable use of natural resources;
- tackling climate change by reducing the greenhouse gas (GHG) emissions that cause climate change and ensuring that places are resilient to the consequences of climate change;

[13] Welsh Government, 2018. Planning Policy Wales, Edition 10. [Online] Available at: https://gov.wales/sites/default/files/publications/2019-02/planning-policy-wales-edition-10.pdf

- applying the precautionary principle. Cost-effective measures to prevent possibly serious environmental damage should not be postponed just because of scientific uncertainty about how serious the risk is;
- using scientific knowledge to aid decision-making, and trying to work out in advance what knowledge will be needed so that appropriate research can be undertaken;
- while preventing pollution as far as possible, ensuring that the polluter pays for damage resulting from pollution;
- applying the proximity principle, especially in managing waste and pollution. This means solving problems locally rather than passing them on to other places or to future generations;
- taking account of the full range of costs and benefits over the lifetime of a development, including those which cannot be easily valued in money terms when making plans and decisions and taking account of timing, risks and uncertainties. This also includes recognition of the climate a development is likely to experience over its intended lifetime; and
- working in collaboration with others to ensure that information and knowledge is shared to deliver outcomes with wider benefits.

2.7.14 Section 6.5 of PPW deals with coastal areas. The main planning principles for coastal places, reflect the principles of Integrated Coastal Zone Management. These principles are 'to support urban and rural development, whilst at the same time being aware of, and appropriately responsive to, the challenges resulting from the dynamic interaction of natural and development pressures in coastal areas.'

2.7.15 Planning Policy Wales states that planning authorities should develop, or apply, specific policies through their development plans which reflect the characteristics of their coastlines. They should acknowledge the interrelationships between the physical, biological and land use characteristics of their coastal areas and the impacts of climate change. This will involve considering the potential impacts associated with incremental increases in coastal risk over time as well as any beneficial incremental changes in land use.

2.7.16 Coastal defences can potentially influence sediment supply by transferring the risks of erosion to elsewhere. Planning Policy Wales states that it is 'not appropriate for development in one area to adversely add to the impacts of physical change to the coast in another location.'

2.7.17 Section 6.6 of PPW deals with Water and Flood risk, with paragraph 6.6.22 dealing specifically with Development and Flood Risk. The plan states that Government resources for flood and coastal defences are directed at protecting existing developments and are not available to provide defences in anticipation of future development. New or improved flood defences in coastal and/or riverside locations should be carefully planned, ensuring all potential environmental effects, both on and off-shore, and relevant SMP policies are taken into account. Flood defence works can provide opportunities to achieve wider social, economic and environmental benefits, which should be maximised where possible.

### Technical Advice Notes

2.7.18 Planning Policy Wales is supplemented by a series of Technical Advice Notes (TANs). TANs should be taken into account by local planning authorities in Wales in the

preparation of development plans. TAN 14 (Coastal Planning)14 and TAN 15 (Development and Flood Risk)15 are of relevance to this project. TAN 14 provides advice on:

- Recreation development
- Heritage coasts and non-statutory coastal groupings
- Shoreline Management Plans

2.7.19 TAN 15 provides advice on:

- Development advice maps to determine flood risk
- Assessing the flooding consequences of proposed development
- Development plans and development control to mitigate flood risk.

### Cardiff Local Development Plan

2.7.20 The Cardiff Local Development Plan16 represents a 'plan-led' approach to meeting future needs. The adopted LDP provides the statutory framework for the development and use of land within Cardiff over the Plan period (2006 to 2026). The LDP states that the Plan 'provides a balanced response to meeting social and economic needs, but in a manner, which best protects our valued open spaces, river corridors and countryside backdrop.' The LDP 'vision', set out in the 'What Matters' Strategy, is: 'By 2020…Cardiff will be a world class European capital city with an exceptional quality of life and at the heart of a thriving city-region'.

2.7.21 The LDP sets out four objectives to deliver the LDP vison:

- to respond to evidenced economic needs and provide the necessary infrastructure to deliver development;
- to respond to evidenced social needs;
- to deliver economic and social needs in a co-ordinated way that respects and enhances Cardiff's environment; and
- to create sustainable neighbourhoods that form part of a sustainable city.

2.7.22 The LDP also aims to protect and enhance river corridors. It provides a planning framework through which the Council is able to protect, promote and enhance river corridors. New development within, or adjacent to the river corridors may be required to contribute to projects which help to achieve the objectives set out in the River Corridor Action Plans.

### River Corridor Action Plan

2.7.23 The purpose of the River Corridor Action Plan is to establish an agreed framework that will deliver a wide range of actions that respond to the key identified priorities. The Rhymney River and Nant Fawr Corridor Action Plan17 is intended to bring about

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[14] Welsh Government, 1998. Technical Advice Note 14: Coastal Planning. [Online] Available at: https://gov.wales/technical-advice-note-tan-14-coastal-planning

[15] Welsh Government, 2004. Technical Advice Note 15: Development and Flood Risk. [Online] Available at: https://gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf

[16] Cardiff Council, 2016. Cardiff Local Development Plan 2006-2026, Adopted Plan. [Online] Available at: https://www.cardiff.gov.uk/ENG/resident/Planning/Local-Development-Plan/Documents/Final%20Adopted%20Local%20Development%20Plan%20English.pdf

[17] Rhymney River and Nant Fawr Corridor Action Plan, 2010. [Online] Available at:

improvements in the valley. The aim of the Action Plan is to bring relevant organisations together to identify issues, agree a framework and deliver actions that:

- positively address identified priorities;
- improve the quality of the environment;
- bring about the sustainable and long-term use of land;
- maximise opportunities for improved access and recreation; and
- raise public awareness of the value of the valley to the community.

### Conservation of Habitats and Species Regulations 2017 and changes made by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019

2.7.24 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, known as the 'Habitats Directive' was adopted in 1992. The Directive promotes the maintenance of biodiversity by requiring Member States to take measures to maintain or restore certain natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance.

2.7.25 The Directive establishes the requirement for a European ecological network of protected sites by designating SACs for habitats listed on Annex I and for species listed on Annex II. These measures are also to be applied to SPAs classified under Article 4 of the Birds Directive. Together SACs and SPAs make up the Natura 2000 network.

2.7.26 The Directive is transposed into law in England and Wales through the Conservation of Habitats and Species Regulations 2017 (as amended). The Regulations require that an HRA is undertaken by a Competent Authority prior to the issue of any consent to consider whether a proposed project is likely to have a significant effect on a Natura 2000 site. Government guidance also requires that Ramsar sites (which support internationally important wetland habitats and are listed under the Convention on Wetlands of International Importance [Ramsar Convention]) are included within an HRA. Together, SACs, SPAs and Ramsar sites are known as 'European sites'). The 2017 Regulations have been amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 Regulations.

2.7.27 The main changes to the 2017 Regulations are:

- the creation of a national site network within the UK territory comprising the protected sites already designated under the Nature Directives, and any further sites designated under these Regulations
- the establishment of management objectives for the national site network (the 'network objectives')
- a duty for appropriate authorities to manage and where necessary adapt the national site network as a whole to achieve the network objectives
- an amended process for the designation of Special Areas of Conservation (SACs)
- arrangements for reporting on the implementation of the Regulations, given that the UK no longer provides reports to the European Commission

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https://www.cardiff.gov.uk/ENG/resident/Planning/Local-Development-Plan/Examination/Core-Document-Library/Cardiff-Council-Docs/Documents/CC21%20River%20Rhymney%20and%20%20Nant%20Fawr%20Corrider%20Action%20Plan%202009.pdf

- arrangements replacing the European Commission's functions with regard to the imperative reasons of overriding public interest (IROPI) test where a plan or project affects a priority habitat or species and
- arrangements for amending the schedules to the Regulations and the annexes to the Nature Directives that apply to the UK.

### Water Framework Directive

2.7.28 The WFD (2000/60/EC) is implemented in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Regulations). The Regulations require that Environmental Objectives are set for all surface and groundwaters in England and Wales to enable them to achieve Good Status by a defined date. These Environmental Objectives are listed below:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological conditions of waters;
- Aim to achieve at least good status for all waterbodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;
- Meet the requirements of WFD Protected Areas;
- Promote sustainable use of water as a natural resource;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Contribute to mitigating the effects of floods and droughts.

2.7.29 Surface waterbody status is made up of biological, physio-chemical, hydromorphological and chemical quality characteristics known as 'quality elements'. These are taken from Annex V of the Directive. The overall status of a waterbody is determined by the lowest element status. Environment Agency guidance states that all quality elements need to be considered as part of a WFD assessment. Groundwater waterbody status is defined by its 'quantitative status' and its 'chemical status'. Two classes are attributed to both quantitative and chemical status: good and poor. Both need to be at good status before the waterbody is classified as good. As retained law, the Directive continues to apply in the UK following the UK's split with Europe.

## 2.8 Environmental constraints

2.8.1 Environmental constraints have been identified up to 1km of the development site, on the basis of a review of readily available environmental information. This includes statutory and non-statutory designated sites and other environmental features (see Table 2-8). Where relevant, further consideration is given to environmental constraints within the baseline section of each of the EIA topic chapters.

**Table 2-9: Key environmental designations identified within 1km of the development site**

| EIA topic | Environmental designation | Within permanent works | Within construction footprint | Within 1km of the permanent works |
|---|---|---|---|---|
| **Biodiversity and nature** | **Special Area of Conservation (SAC)** | Severn Estuary SAC | Severn Estuary SAC | - |

| EIA topic | Environmental designation | Within permanent works | Within construction footprint | Within 1km of the permanent works |
|---|---|---|---|---|
| **conservation** | **Special Protection Area (SPA)** | Severn Estuary SPA | Severn Estuary SPA | - |
| | **Ramsar Site** | Severn Estuary Ramsar | Severn Estuary Ramsar | - |
| **Historic environment** | **Listed building** | X | X | Rumney Pottery (13761) Grade II listed 400m northwest of site |
| | **Scheduled monument** | X | X | Relict Seawall on Rumney Great Wharf (GM474) 800m east of the site |
| | **Historic Landscape of Outstanding Historic Interest in Wales** | X | Gwent Levels | X |
| **Landscape** | **Area of Outstanding Natural Beauty** | | | |
| | **Area of Great Landscape Value** | | | |

# 3 Environmental Impact Assessment methodology

## 3.1 The EIA process

3.1.1 Regulation 4 of the Town & Country Planning (Environmental Impact Assessment) Regulations 2017 states that:

*(1) The environmental impact assessment is a process consisting of:*

*(a) the preparation of an environmental statement.*

*(2) The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of proposed development on the following factors:*

*(a) population and human health;*

*(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC(1) and Directive 2009/147/EC(2);*

*(c) land, soil, water, air and climate;*

*(d) material assets, cultural heritage and the landscape; and*

*(e) the interaction between the factors listed in sub-paragraphs (a) to (d).*

3.1.2 EIA is defined as 'a systematic process to identify, predict and evaluate the environmental effects of proposed actions and projects'1. Online Government guidance2 defines the aim of EIA 'to protect the environment by ensuring that a local planning authority, when deciding whether to grant planning permission for a project which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision-making process' and 'to ensure that the public are given early and effective opportunities to participate in the decision making procedures'.

3.1.3 The EIA process is closely aligned with the design process ( Figure 3-1)18. This effectively begins with EIA screening, whereby the developer makes the decision whether EIA is required for the project in question. Suitable environmental alternatives (primary mitigation) should be considered at this early stage, but if it is decided that the potential likely significant effects on the environment cannot be avoided through mitigation measures, an EIA screening opinion should be sought from the appropriate authority by the developer. As well as the outline design details, some environmental information is required to undertake EIA screening, and so baseline surveys may be required to inform the EIA screening request.

3.1.4 It is often appropriate where EIA screening identifies the need for a statutory EIA, that EIA scoping is undertaken to confirm the scope of the assessment work required. Through the submission of an EIA Scoping Report, the developer requests that the relevant authority provide an EIA scoping opinion in order to seek confirmation from the statutory environmental consultees on the scope of the EIA required.

3.1.5 On the basis of the EIA scoping opinion response, further detailed baseline information is sometimes collected to inform the detailed impact assessments. The assessment involves firstly characterising the potential impacts and then the assessment of likely significant effects. At this stage primary, secondary and tertiary mitigation can be recommended to reduce or eliminate significant effects. This is an iterative process,

[18] Institute of Environmental Management and Assessment (IEMA) (2016) *Environmental Impact Assessment Guide to Shaping Quality Development*. https://www.iema.net/assets/uploads/iema_guidance_documents_eia_guide_to_shaping_quality_development_v7.pdf

through which the impact assessment process and design of the development process interact to produce a mutually acceptable solution. This can also involve stakeholder engagement of the emerging design, to further minimise environmental effects. The results of the EIA process are documented in the ES, which should be a well-structured, proportionate and concise document.

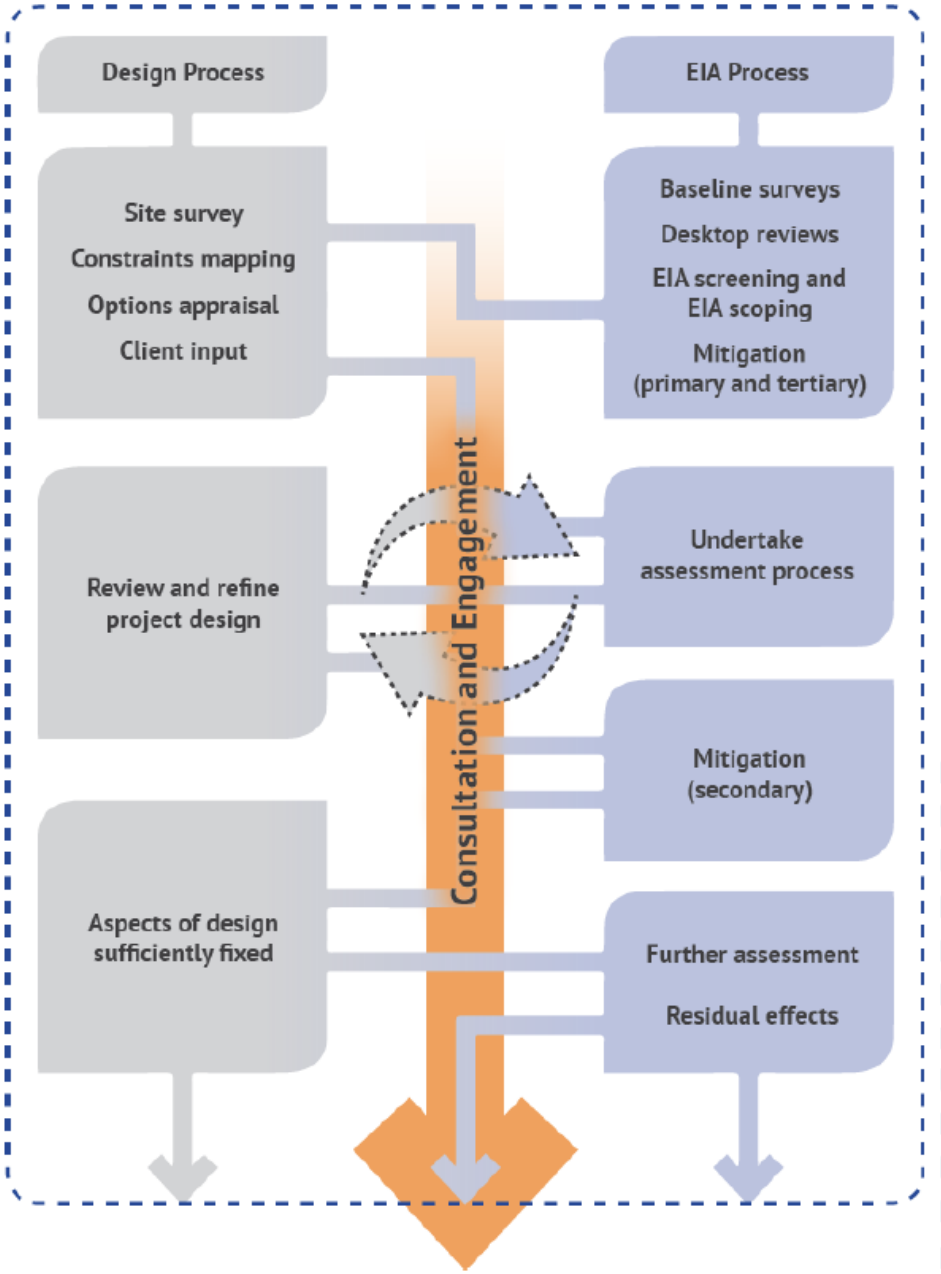



**Figure 3-1: The interaction of design and EIA processes[18]**

3.1.6 Secondary and tertiary mitigation recommendations and commitments reported in the ES topic chapters often require separate environmental management plans in order to achieve the desired outcome. These are usually prepared during discharge of planning conditions or during pre-construction stage of the approved development but can be prepared in draft at the planning stage to demonstrate that commitments in the ES will be followed up.

3.1.7 With reference to the Institute of Environmental Management and Assessment (IEMA) (2016) a summary of the steps involved in the EIA process is set out as follows:

1 Identify aspects of environment likely to be significantly affected (preliminary baseline);
2 Propose primary mitigation (impact avoidance measures);
3 Define impact assessment methodology;
4 Collect environmental baseline;
5 Assess likely significance of the effects;
6 Propose secondary mitigation (iterate design to reduce or eliminate effects);
7 Report residual effects (in the relevant ES chapter); and
8 Set out follow up measures (tertiary measures and environmental management plan).

## 3.2 EIA screening and scoping

### EIA screening and scoping opinion request and response

3.2.1 An EIA Screening and Scoping Report was submitted to Marine Licencing team at NRW on the 19th February 2021 and to Cardiff Council and on the 23rd February 2021. NRW responded with its formal opinion on the 14th April 2021 (see Appendix A) and the Council on the 16th April 2021 (See Appendix B). The opinion stated that NRW falls within Schedule A2, paragraph 69 of the above regulations and therefore must be considered in terms of size, nature and location having regard to the relevant criteria set out in Schedule 1 of the Marine Works EIA Regulations. The opinion the Council considered was that the proposed development falls within Schedule 2, Paragraph 10(h), and Schedule 3 of the EIA (Wales) Regulations 2017. The opinions identified that the "scheme exceeds the relevant screening thresholds given in Schedule 2 of the EIA Regulations for "Coastal work to combat erosion and maritime works capable to altering the coast through construction"."

3.2.2 The objective of EIA scoping is to consider the scope and level of detail of the information to be provided in the ES (Regulation 14(1)). Often, before an ES is prepared, an EIA Scoping Report is authored as part of the scoping stage. The Scoping Report sets out a proposed methodology for the assessment of likely significant effects based on reasonably accessible environmental baseline information and propose an appropriate structure for the ES. It is not a statutory requirement to undertake EIA scoping.

3.2.3 Environmental issues that are 'scoped in' require further detailed technical studies undertaken to inform the ES. Where environmental issues are 'scoped out', these would not be considered further unless there is a material change in the outline scheme proposals.

3.2.4 A summary of the comments raised by Cardiff County Council, NRW, and the statutory consultees is provided in Table 3-1, with the full responses provided in Appendices A and B.

**Table 3-1: Summary comments raised in the EIA scoping opinion response and where the comment is addressed in the ES**

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| **Cardiff Council – Ecology Officer** | Include how harm can be avoided or mitigated to local designated sites to ensure no overall reduction. | Addressed through National Habitat Creation Programme |

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| | Common Lizards should be accounted for. | Chapter 5 |
| | Nesting bird surveys should include ground nesting species, particularly Lapwing. | Chapter 5 |
| | Dormice should be referenced as a species for consideration as they have been detected on the Gwent Levels and at Howardian LNR. | Chapter 5 |
| | Areas identified for compensatory habitat creation from the Appropriate Assessment should be considered in the EIA process. | Addressed through National Habitat Creation Programme |
| | Consider the impacts upon ecosystems as well as habitats and species, demonstrating how they have been assessed in accordance with the 2018 EcIA Guidelines. | Chapter 5 |
| **Cardiff Council – Tree and Landscape Officer** | Consider impact on trees | Impact on trees and proposed replacement planting to be confirmed in advance of construction when working areas confirmed. |
| | There was no consideration of soils which has the potential to be substantially disturbed and impact on its functionality. Mitigation measures could include a Soil Resource Survey and Plan. | Soils will be re-used on site – plans proposed. |
| **Cardiff Council – Shared Regulatory Services Environment Team** | Any areas of concern either not considered or identified by the submitted assessments at the application stage can be delt with by the inclusion of geo-environmental conditions. | Information on adjacent contamination pathways included below - any remaining issues to be addressed by way of condition. |
| **Cardiff Council – Harbour Authority** | An assessment of sediment dynamic change impacts will be done and the Authority will require reassurance that the scheme would not increase sediment deposition in the vicinity of the Barrage which could impact their dredging operations. | Sediment assessed within Chapter dealing with Coastal Processes |
| **Cardiff Council – Public Right of Way Officer** | Routing the Wales Coast Path around the traveller's site is challenging and is currently diverted inland. The PRoW is still open for that public and the potential views from the Coast Path into the traveller's site needs to be considered. Natural screening along their boundary should be considered however any works along this section should involve consultation with the traveller community. | Additional screening and planting proposed. Discussed in the landscape chapter and mitigation plan. |
| | The WCP around the Biomass Plant should have security with gates/boulders to prevent illegal access should be provided. | Issue for Biomass Plant. |
| | There are invasive weeds (especially Japanese Knotweed) along the route which requires treatment prior to the works being undertaken and long term monitoring. | Treatment to be arranged. |
| | A Temporary Traffic Regulation Order will be required to close the public footpath. This is for a maximum 6 months but an extension can be applied for however, there is no guarantee this will be granted. | To be arranged by the successful contractor. |

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| **Cardiff Council – Traffic and Transport** | The 10% additional traffic associated with the construction phase is disputed as being insignificant due to Rover Way potentially operating at near capacity therefore, any increase could be very significant. | Potential disruption during construction to be assessed within Construction Traffic Management Plan – to be submitted and agreed prior to construction. |
| **Glamorgan Gwent Archaeological Trust** | Any impacts of the proposed works could be mitigated by a range of archaeological interventions such as a watching brief or small scale investigation/recording in advance of construction. | Archaeological Watching Brief set out within the Historic Environment Chapter. |
| **Cadw** | The impact on the registered Gwent Levels landscape of outstanding historic interest will need to be considered and suggests that it should be assessed using the methodology outlined in the Welsh Government document "The Setting of Historic Assets in Wales". | Addressed in Historic Environment Chapter. |
| **Dwr Cymru Welsh Water** | The following is advised:<br>• Areas of the proposed scheme are located on top of, or close to, a number of public clean water and sewerage assets.<br>• DCWW requires access to its assets at all times to carry out maintenance and repairs. | Noted. |
| **NRW – General** | The EIA must include a competent expert statement. | Included in Chapter 3 |
| | Other environmental assessments should be coordinated with the EIA process for example, HRA and WFD. | HRA and WFD also considered. |
| | Transboundary impacts should be considered where appropriate | No transboundary impacts considered likely. |
| | If habitat loss of the Severn Estuary SAC cannot be avoided, minimise the footprint of the activity as much as possible. | The design proposed has sought to minimise impact on the SAC. |
| | A detailed coastal processes assessment will be required along section 1. | Considered within the Geomorphology and Coastal Processes Chapter 4. |
| | Sediment management must be considered as a large amount will be disturbed during the works. NRW TE do not recommend any mobile sediment being locked out of the active marine zone. | Considered within the Geomorphology and Coastal Processes Chapter 4. |
| | Rock storage and placement should be considered and assessed. | Rock storage will be on land with rock brought in by road. |
| | Direct or indirect SAC losses are unclear in section 2 therefore it is advised that engagement with NRW TE is done. | Impact on the SAC has been considered and discussion with NRW TE undertaken. |
| | Provide justification regarding the extent of the works and | Considered within |

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| | whether as minimal a footprint as possible has been considered at section 3. | the Geomorphology and Coastal Processes Chapter 4. |
| | An assessment must be carried out on plume effects and a management plan on subsequent placement of sediment that will be disturbed at section 3. | Considered within the Geomorphology and Coastal Processes chapter 4. |
| | NRW TE are concerned about the stability and functionality of the biodiversity enhancement of the sediment that will be placed on the upper slope of section 3. There is also little chance for more sediment to settle out on the upper slope as they will only be inundated at the highest tide. | Considered within the Geomorphology and Coastal Processes chapter 4. |
| | NRW TE are concerned that the design may lead to the saltmarsh being permanently disconnected from the mudflat at section 3. | |
| | NRW TE are concerned that the form and function of the channel may be permanently altered due to the extensive works. | Considered within the Geomorphology and Coastal Processes chapter. |
| | Carry out geomorphological modelling to consider the potential impact of the works on the salt marsh habitat in section 4 on the Eastern Bank of the Rhymney River. | Considered within the Geomorphology and Coastal Processes chapter. |
| | Encourage engagement with NRW TE to consider appropriate mitigation or compensation requirements for mudflat and saltmarsh habitat. | Considered within the Geomorphology and Coastal Processes chapter. |
| | Encourage engagement with NRW TE as a detailed coastal squeeze assessment is carried out. | Considered within the Geomorphology and Coastal Processes chapter. |
| | Encourage engagement with NRW TE as the CEMP is developed using NetRegs GGP5 and CIRIA guidelines. | CEMP to be developed as a Planning and ML Condition |
| | Routes for vehicle movement should be planned to avoid the most sensitive areas. | Access requirements are included within the red line boundary. |
| | A realistic worst-case scenario for the construction programme should be considered. | Programme considered. |
| **NRW – Coastal processes and geomorphology** | An operational model and assessment of the scheme is advised to be undertaken to understand likely impacts on the estuary form and function. | Considered within the Geomorphology and Coastal Processes chapter. |
| | NRW TE encourages the use of softer engineering techniques to provide a more natural approach than hard engineering. | Considered within the Geomorphology and Coastal Processes chapter. Bio-engineering is proposed on upper slopes. |
| | The potential effects of released fine sediments on WFD | Considered within |

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| | biological elements should be considered. | the Geomorphology and Coastal Processes chapter. Sediment not considered a significant risk due to the context of high sediment loads within the Severn Estuary. |
| | Potential impact on additional WFD biological elements must be considered in terms of temporary and permanent impacts. | Considered within the WFD assessment. |
| **NRW – Biodiversity and nature conservation** | NRW TE advise that any changes in the location of the Wales Coastal Path that breaks the skyline, an assessment of disturbance to wintering and migratory bird species must be included. | Noted – no change. |
| | Impact to wintering/migrant species should be considered with regard to the percentage of populations impacted and to the proximity of the Redshank roost. | Chapter 5 |
| | NRW TE highlight that there is an important Dunlin roost to the east of the development site which should be assessed. | Chapter 5 |
| | NRW TE advises that works near the roosts should not be conducted during the winter months. If unavoidable, works should be staged or staggered. | Noted |
| | NRW TE advise that research published on the impact of the loss of Cardiff Bay mudflats may support the assessment. | Noted |
| | If any piling occurs, the impact associated with underwater noise and vibration on fish species and marine mammals must be considered along with the risk of causing injury or mortality to individuals. As mitigation, it is advised that piling should only occur at tidal states where there is sufficient distance between the piling and the channel. | Piling impacts considered in Chapter 5 and HRA. |
| | Appropriate working practices and mitigation measures for fish should be included in the CEMP and Method Statement. | CEMP to be prepared by successful contractor prior to the start of construction. |
| | Introduction and spread of INNS should be scoped in and the impacts assessed for both the construction and operational phases. | INNS considered. |
| | Impacts on coastal processes should be scoped in and assessed for both the construction and operational phases. | Included in Chapter 4 |
| | NRW TE advise that there is the potential for changes in sediment regime to impact the *Sabellaria alveolata* reef 2km from the scheme and therefore should be assessed. | Chapter 4 assesses zone of influence/likely extent of impacts. |
| | The amount of SAC habitat lost due to construction and operation must be calculated, assessed and included in the ES. | Calculated and discussed in Chapter 5 and HRA. |
| | Further detail to demonstrate how permanent habitat loss will be minimised will be required in the ES. | Design alternatives considered. |
| | It is advised that potential opportunities for environmental enhancement measures to be incorporated into the scheme | Opportunities discussed during |

| Consultee | Summary of comment | Where in the ES |
|---|---|---|
| | is discussed with NRW TE. | workshop. |
| | NRW TE advises that a full Biosecurity Risk Assessment and INNS Management Plan in completed. | Potential planning condition |
| | NRW TE advise that quadrats should be used to record the finer scale variations within the saltmarsh NVC survey. | NVC survey undertaken. |
| | Potential impact on otters, great crested newts and water voles must be assessed and included. | Chapter 5 |
| | If any stands of scrub or trees are removed, the impact on dormice should be considered. | Dormice considered |
| | The ES should set out how the long-term site security of any mitigation or compensation requirements will be assured. | Compensation to be delivered through National Habitat Creation Programme (NHCP) |
| | It is advised that engagement with NRW TE and the Local Authority Ecologist occurs to ensure that regional and local biodiversity issues are adequately considered. | Discussion undertaken. |
| **NRW – Historic Environment** | The impact on the registered Gwent Levels landscape should be assessed | Considered within the Historic Environment Chapter – Chapter 7 |
| | An assessment must be carried out to consider the potential impact on undesignated archaeological sites. | Considered within the Historic Environment Chapter – Chapter 7 |
| **NRW – Construction-related effects** | We recommend that the Phase 1 Geo-Environmental Desk Study and Geotechnical Ground Investigation reports are included. | Included – Appendix L |
| **NRW – Cumulative effects** | The ES must include an assessment of cumulative and in-combination effects | Included – Chapter 9 |

3.2.5 On the basis of the scoping opinion received, the scope of the EIA encompasses the following environmental topic areas:

- Coastal Processes and Geomorphology
  - Coastal processes impact
  - Coastal hydrology
- Biodiversity and Nature Conservation
  - Effects on species and habitats from construction and operation.
  - Effect on wintering and migratory birds.
  - INNS introduction and spread during construction and operation.
- Landscape and Visual
- Historic Environment
  - Direct effects on features of archaeological interest.
  - Wentlooge Levels
- Climate Change
  - Climate change adaptation and resilience
  - Construction GHG emissions

3.2.6 The following topics have been excluded from the scope of the EIA and are not described in this ES:

- Population and Human Health
- Construction-related effects
- Heat and radiation
- Air Quality
- Construction and Operational Noise
- Construction and Operational Vibration
- Light
- Traffic and Transport (transport approach covered under construction – Construction Traffic Management Plan to be prepared and agreed prior to construction).
- Construction-related effects
- Traffic noise
- Land Contamination
- Waste Management
- Other environmental effects
- Flood Risk
- Land Use
- Material Assets
- Major Accidents

## 3.3 The Environmental Statement

3.3.1 With reference to Regulation 17(3) of the Town & Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017, the ES must contain the information specified in Schedule 4 'relevant to the specific characteristics of the particular development or type of development and to the environmental features likely to be significantly affected'. Table 3-2 sets out the sections of the ES in which this information is addressed.

**Table 3-2: Requirement of Schedule 4 and where requirements are addressed in the ES**

| Chapter | Requirement | Where in the ES |
|---|---|---|
| 1 | A description of the development, including in particular:<br>(a) A description of the location of the development;<br>(b) A description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases;<br>(c) A description of the main characteristics of the operational phase of the development (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used;<br>(d) An estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases. | Section 1.2 and sections 2.3 to 2.7 |
| 2 | A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the | Section 2.3 |

| Chapter | Requirement | Where in the ES |
|---|---|---|
| | environmental effects. | |
| 3 | A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge. | Section 2.2 chapters 4 to 10 |
| 4 | A description of the factors specified in Regulation 4(2) likely to be significantly affected by the development:<br>Water | Chapter 4 |
| | Biodiversity | Chapter 5 |
| | Landscape | Chapter 6 |
| | Cultural heritage, including architectural and archaeological aspects | Chapter 7 |
| 5 | A description of the likely significant effects of the development on the environment resulting from, inter alia:<br>(a) The construction and existence of the development, including, where relevant, demolition works;<br>(b) The use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources;<br>(c) The emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;<br>(d) The risks to human health, cultural heritage or the environment (for example due to accidents or disasters;<br>(e) The cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;<br>(f) The impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change; and<br>(g) The technologies and substances used.<br>The description of the likely significant effects on the factors specified in regulation 4(2) should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term or long-term, permanent and temporary, positive and negative effects of the development. This description should take into account the environmental protection objectives established at Union or Member State level which are relevant to the project, including in particular those established under Council Directive 92/43/EEC(a) and Directive 2009/147/EC(b). | Chapters 4 to 10 |
| 6 | A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (for example technical difficulties or lack of knowledge) encountered compiling the required information and the main uncertainties involved. | Chapters 4 to 10 |
| 7 | A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases. | Chapters 4 to 10 |
| 8 | A description of the expected significant adverse effects of the | N/A. Scoped out at |

| Chapter | Requirement | Where in the ES |
|---|---|---|
| | development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned.* Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies. | scoping stage |
| | *Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU(c) of the European Parliament and of the Council or Council directive 2009/71/Euratom(d) or UK environmental assessments may be used for the purpose provided that the requirements of this Directive are met. | |
| 9 | A non-technical summary of the information provided under paragraphs 1 to 8. | Non-Technical Summary |
| 10 | A reference list detailing the sources used for the description and assessments included in the environmental statement. | References |

## 3.4 EIA method of assessment

3.4.1 As noted above Regulation 17(4)(d) states that the ES must 'include the information reasonably required for reaching a reasoned conclusion on the significant effects of the development on the environment, taking into account current knowledge and methods of assessment'. Reference is made to the current EIA practice guidance, primarily:

- Online Government Guidelines[19].
- Guidelines for Environmental Impact Assessment (IEMA, 2004) and 2006 updates[20].
- IEMA (2011) State of Environmental Impact Assessment Practice in the UK. Special Report[21].
- IEMA (2016) Environmental Impact Assessment Guide to Shaping Quality Development[18].
- IEMA (2016) Environmental Impact Assessment Guide to Delivering Quality Development[22].
- Other environmental topic-specific guidance is detailed within each ES chapter.

### 3.4.2 Statement on competent expertise

3.4.3 As noted above Regulation 17(4)(b) requires that the ES must set out a 'statement by or on behalf of the applicant or appellant describing the expertise of the person who prepared the environmental statement'.

3.4.4 The JBA Consulting EIA Policy Statement requires that the appropriately qualified and experienced competent experts have the authority to technically review and approve EIA deliverables forming part of statutory ES reports coordinated by JBA. The EIA has been prepared by a multi-disciplinary team of environmental specialists as set out in Table 3-3. Overall coordination of the ES was overseen and technically reviewed by Tim Carter BSc MSc CMLI MIEMA CEnv.

[19] https://www.gov.uk/guidance/environmental-impact-assessment

[20] IEMA (2004). Guidelines Environmental Impact Assessment. 2006 Updates.

[21] IEMA (2011). State of Environmental Impact Assessment in the UK. IEMA Special Report.

[22] IEMA (2016). Environmental Impact Assessment Guide to Delivering Quality Development. https://www.iema.net/assets/newbuild/documents/Delivering%20Quality%20Development.pdf

**Table 3-3: EIA team and qualifications**

| EIA topic chapter | EIA chapter author | EIA chapter reviewer |
|---|---|---|
| Geomorphology and Coastal Processes | Anissia Halwyn BSc PhD | Anne-Marie Moon BSc MSc CEng MICE |
| Biodiversity and Nature conservation | Jonathan Harrison BSc MSc MCIEEM | Laura Thomas BA MRes PGCert CEcol MCIEEM |
| Landscape | Mark Willy BSc MA CMLI | Tim Carter BSc MSc CMLI MIEMA CEnv |
| Historic Environment | Kristian Evans BA MSc | Dorothy Graves McEwan PhD MCIfA FSA Scot |

### 3.4.5 Defining the temporal and spatial scope of EIA

3.4.6 Regulation 17(3) states that the ES includes at least: (a) 'a description of the proposed development comprising information on the site, design, size and other relevant features of the development…'

3.4.7 The temporal scope of the EIA is considered in terms of the following principal stages of development:

- existing conditions (baseline);
- construction;
- operation (including maintenance) of the development; and
- future decommissioning of the development.

3.4.8 The spatial scope of the EIA is considered on the basis of:

- the physical extent of the proposed works, as defined by the limits of land to be acquired or used (temporarily or permanently);
- the nature of the existing baseline environment, including the location of sensitive receptors;
- the geographical extent of impacts beyond the site, e.g. effects on traffic, or watercourses that might extend some distance from the development site; and
- the geographical boundaries of the political and administrative institution and authorities, which provide the planning and policy context for the project.

### 3.4.9 Defining impacts and effects

3.4.10 Schedule 4 of the EIA Regulations sets out the requirement of Regulation 17(3) that the ES provides both a description of the characteristics of the proposed development together with a description of the aspects of the environment likely to be significantly affected, including the following: 'population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape'.

3.4.11 With reference to Schedule 3, which sets out the Regulation 5(8) selection criteria for EIA screening, the requirement for EIA is set out on the basis of: 1. the characteristics of the development; 2. the environmental sensitivity of geographical areas likely to be affected by development; and 3. the types and characteristics of the potential impact to identify the likely significant effects of the development on the environment. The EIA should seek to identify the value, sensitivity or importance of the aspects of the environment, where they are likely to be affected by the development proposals,

characterise the nature of any impacts on these aspects of the environment, and then assess the overall significance of the effect that would result if left unmitigated.

3.4.12 Distinction is drawn between characteristics of 'impacts' and the significance of 'effects', as not all impacts identified will necessarily have a likely 'significant' effect on the environment. Impacts and effects are defined in the ES as follows:

- Impacts are the predicted changes to the baseline environment attributable to the development; and
- Effects are consequences of impacts on environmental resources or receptors of a particular value, sensitivity or importance.

### 3.4.13 Assessment of significance

3.4.14 Schedule 4 of the EIA Regulations also requires a description of the factors likely to be significantly affected by the development using the following terms, which are defined for the purpose of this EIA thus:

- Direct Effects – effects that are caused by activities which are an integral part of the proposed development (e.g. land take);
- Indirect Effects – effects arising indirectly from the construction or use of a development (e.g. supply chain effects in construction stage, resident's local expenditure in operational phase);
- Secondary Effects – are 'knock-on'/once-removed effects arising in consequence of indirect effects (e.g. the decision of firms to locate in a particular area following nearby transport infrastructure upgrades);
- Cumulative Effects – effects that result from different sources or would be considered in different assessments but which affect a common receptor and common receptors and mean that the affected receptor(s) could experience a greater, synergistic, effect;
- Transboundary Effects – effects caused by a proposed development that are experienced across a boundary;
- Temporary Effects – environmental effects that occur during the construction of a project will typically be temporary.
- Permanent Effects – permanent effects are those which are irreversible (e.g. permanent land take), will last for the foreseeable future (e.g. noise from generated road traffic) or are effects considered to last greater than ten years;
- Beneficial Effects – effects that have a positive influence on the environment; and
- Adverse Effects – effects that have an adverse influence on the environment.

3.4.15 Consideration of transboundary effects are also a requirement of Schedule 4, which in the UK are considered with regard to the geographical boundaries of the political and administrative institution and authorities, which provide the planning and policy context for the project.

3.4.16 Significance of environmental effects is assessed herein on the basis of the magnitude, intensity or irreversibility of impacts versus the value, sensitivity or importance of the impacted environmental resource or receptor. Where applicable, Table 3-4 will be used to assist in the judgement of significance. This matrix-based approach helps to provide consistent significance terminology throughout the ES and improves the judgement of significance scoring by pre-defining the relationship between impacts and effects. For consistency the significance of environmental effects assessment scores will be described using these terms where possible, with topic specific terminology set out in individual ES chapters where guidelines deviate from the standard approach.

**Table 3-4: Matrix of significance of effect scoring terms**

| | | Magnitude, intensity or irreversibility of impact | | | |
|---|---|---|---|---|---|
| | | **No Change** | **Minor** | **Moderate** | **Major** |
| **Magnitude, intensity or irreversibility of impact** | **Low** | Not Significant or Neutral | Slight | Slight or Moderate | Moderate |
| | **Medium** | | Slight or Moderate | Moderate | Moderate or Large |
| | **High** | | Moderate | Moderate or Large | Large |

### 3.4.17 Mitigation, enhancement and reporting of residual effects

*3.4.18 Schedule 4 of the EIA Regulations sets out the requirement for inclusion in the ES: 'A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases'.*

3.4.19 Mitigation measures should be both reasonable and practicable, taking account of the following criteria:

- current best practice guidance;
- precedents set by similar projects;
- the effectiveness of different technical solutions;
- their feasibility in construction and operational terms; and
- their incremental costs.

3.4.20 When identifying the best possible design measures available to achieve the required mitigation within a scheme, the principles of the hierarchy of mitigation should be employed as follows (in order of preference):

- Avoidance – making changes to the project's design to avoid or prevent adverse effects on an environmental feature;
- Reduction – where avoidance is not possible, adverse effects can be reduced through sensitive environmental treatments/design;
- Remediation – where adverse effects are unavoidable, management measures can be introduced to limit their influence; and
- Compensation – where avoidance on reduction measures are not available, it may be appropriate to provide compensatory measures to seek to offset the adverse effect with a comparable positive one.

3.4.21 Consideration to mitigation should be undertaken from the earliest possible design stage, after the baseline data has been collected, and throughout the EIA process. EIA mitigation can also therefore be characterised depending on the stage of the assessment when it is considered[21].

- *Primary* – Changes made in the pre-application phase of the development, that modify the location or design of the development. This mitigation has the greatest ability to avoid impacts. They are the most effective when applied as early as possible, as it is often difficult to act on primary mitigation measures as the design begins to stabilise.
- *Secondary* – Actions that require activity to achieve a desired mitigation. These can be imposed in the ES in order to achieve planning consent.

- *Tertiary* – Actions that would have been undertaken regardless of the EIA process, due to other legislative requirements or standard practices. This mitigation is the least flexible – either the legislation exists to create the mitigation or does not (i.e., Protected Species Licencing).

3.4.22 Where positive effects can be voluntarily introduced without the requirement to mitigate an effect, this is termed 'enhancement'.

3.4.23 Any environmental effects that remain significant after mitigation are termed 'residual effects'. Residual effects are a convenient way of reporting the overall significance of environmental effects of a proposed development scheme and would therefore be reported in the ES conclusion and NTS.

### 3.4.24 Limitations and assumptions

3.4.25 The following overarching assumptions and limitations are relevant to the ES:

- An outline construction programme was available, but a detailed construction methodology, including sequencing and phasing of works was not. As a result, temporally-reliant construction impacts in specialist chapters were based upon assumptions of the occurrence of certain elements of work.

3.4.26 Topic chapter specific limitations and assumptions are set out in the methodology section of the relevant topic chapter.

# 4 Geomorphology and Coastal Processes

## 4.1 Introduction

4.1.1 This chapter assesses the potential for the proposed scheme to cause likely significant effects on geomorphology and coastal processes within the Severn Estuary. In addition to the issues defined at the scoping stage, a range of environmental issues were raised in the EIA scoping response provided by CCC and the NRW in April 2021. A summary of the issues identified of relevance to this chapter include:

- The influence of the proposed structures on local hydrodynamics within the context of the wider functioning of the Severn Estuary.
- Potential impacts on estuary form and function, with focus on intertidal habitat.
- Potential impacts on sediment dynamics, especially in relation to soft engineering techniques and sediment management during construction.

## 4.2 Baseline Conditions

### Introduction

4.2.1 Gaining an appreciation of the baseline conditions at, and in the vicinity of, each site is essential to identify ongoing physical processes. By using this information, potential impacts of the scheme can then be identified and assessed. Proxies from nearby coastline have been used where site-specific information is unavailable. The key interest areas for this chapter are:

- Hydrodynamics (wave climate and tidal regime)
- Estuarine morphology
- Sediment dynamics and transport

### Tidal regime

4.2.2 The River Rhymney flows into the Severn Estuary, which is macrotidal, with the second largest tidal range in the world. Present day Mean High Water Spring (MHWS) is 6mAOD, whilst Mean Low Water Spring is -5.1mAOD, giving a mean spring tidal range of approximately 11m. Tidal planes for Cardiff are presented in Table 4-1. The River Rhymney is tidal up to the weir adjacent to Rumney Rugby Football Club.

**Table 4-1: Cardiff Tidal Planes (from Admiralty Total Tide in JBA Consulting 2017)**

| Tidal plane | Level (mAOD) |
|---|---|
| Highest Astronomical Tide (HAT) | 7.3 |
| Mean High Water Spring (MHWS) | 6.0 |
| Mean High Water Neap (MHWN) | 2.8 |
| Mean Sea Level (MSL) | 0.3 |
| Mean Low Water Neap (MLWN) | -2.3 |

| Tidal plane | Level (mAOD) |
|---|---|
| Mean Low Water Spring (MLWS) | -5.1 |
| Lowest Astronomical Tide (LAT) | -6.4 |

4.2.3 The Severn Estuary becomes increasingly flood dominant upstream of Avonmouth where the channel is shallower, causing a short, steep rise in the tidal curve, followed by a much less steep, slower ebb tide. However, downstream of Avonmouth (including the study area), the estuary becomes ebb dominant. The large tidal range causes very strong tidal currents within the main estuary, which create deep channels and a very large suspended sediment load. The currents also sort sediments within the estuary, with coarser materials found within channels, whilst the intertidal margins are composed of finer sediment.

4.2.4 The tidal stream is impacted locally at the confluences of large tributaries, causing dynamic morphology at the confluence. Generally, the flow of freshwater from tributaries into the estuary is negligible, as the tidal prism within the Severn Estuary dominates, but large amounts of sediment may be inputted during high fluvial flow events. Where the incoming tide meets the fluvial flow from the opposite direction, an area of slack flow is created, causing the deposition of sediment from both marine and fluvial sources.

4.2.5 The extreme sea level dataset (Environment Agency, 2018) of still water design sea level estimates from the UK coastline was used to obtain sea level estimates at Cardiff. These estimates update and replace those from a previous study in 2011 (Environment Agency 2011). The extreme sea levels provided are to a base year of 2017 (Table 4-3).

4.2.6 Guidance for climate change sea level rise allowances is provided in 'Adapting to Climate Change: Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales' (Welsh Government 2021). Sea level rise estimates were based on the latest UKCP18 sea-level change guidance using the RCP8.5 95th percentile scenario. The predicted increases for sea level rise for the study area are provided in Table 4-2. Predicted extreme sea levels for future years, taking into account climate change are provided in Table 4-3. The data shows that the predicted extreme still water level for a 0.5% AEP event is currently 8.0mAOD, which is predicted to rise to 9.33mAOD by 2120. The estimated extreme sea levels only account for still water sea levels. Therefore, water levels may be even higher when incorporating the effects of wave action. Surges may also have short term effects on the tidal curve, affecting the length of time total sea level is elevated above a particular sea level.

**Table 4-2: Sea level rise allowances for climate change**

| Mean sea level rise by 2100 (m) | Mean sea level rise by 2120 (m) |
|---|---|
| 1.11 | 1.33 |

**Table 4-3: Estimated extreme sea levels for Cardiff**

| Event (% Annual Exceedance Probability) | Current extreme Sea Levels (mAOD) | 2100 Extreme Sea Levels (mAOD) | 2120 Extreme Sea Levels (mAOD) |
|---|---|---|---|
| HAT | 7.2 | 8.31 | 8.53 |
| MHWS | 6.0 | 7.11 | 7.33 |
| 50 | 7.2 | 8.31 | 8.53 |
| 10 | 7.5 | 8.61 | 8.83 |
| 5 | 7.6 | 8.71 | 8.93 |
| 2 | 7.7 | 8.81 | 9.03 |
| 1 | 7.9 | 9.01 | 9.23 |
| 0.5 | 8.0 | 9.11 | 9.33 |

### Wave climate

4.2.7 Comparatively large Atlantic Ocean swell waves are substantially reduced on their approach towards Cardiff foreshore, firstly by diffraction around Lavernock Head, and then through breaking, refraction and friction across the Cardiff Flats (JBA Consulting 2017).

4.2.8 The Severn Estuary wave climate is therefore predominantly wind-generated. Large expanses of intertidal flat generally reduce wave fetches, especially at lower water levels, but during high tide, fetch distances can be greatly increased.

4.2.9 On the more exposed parts of the coastal frontage at the mouth of the Rhymney River, estimated wave heights at the toe of the defence for a 0.5% AEP joint probability wave and water level event are between 0.5m and 1.5m with a peak period (Tp) of between 2.83s and 3.64s. Therefore, wave conditions are not extreme on this part of the coastline, due to the dissipative effects of the intertidal flats. Within the Rhymney River itself, wave action is negligible due to the short fetch distances.

4.2.10 As sea levels rise, locally generated wave heights are predicted to increase as fetch distances increase.

### Sediment dynamics

4.2.11 Sediment transport within the Severn Estuary, including the tidal section of the River Rhymney, is predominantly controlled by tidal currents. In a report by JBA Consulting (2021a), a review of relevant literature and additional data in the SMP2 (Atkins 2010) showed that coastal dynamics in the vicinity of the study area and the wider Severn Estuary are highly variable, both spatially and temporally. Sediment transport is significant within the estuary, with dominant sediment transport of marine sands occurring on the flood tide. The ebb is slower flowing, therefore cannot remobilise all the material, causing deposition within the upper reaches of the estuary. Muds mainly enter the estuary from fluvial sources. There are extremely high loads of suspended sediment in the estuary, again the most dominant pathway occurring up-estuary. However, strong tidal flows tend to prevent permanent accumulation, with mud particles remaining in suspension for most tides. Figure 4-1 and Figure 4-2 conceptualise sand and fine sediment circulation within the estuary. Figure 4-1 shows how sand moves in a dominant eastward pathway, with recirculation pathways occurring in the location of sandbanks. Some sand may be transported back towards

the mouth of the estuary, but this is via the southern sand zone (Kirby and Parker 1982). Figure 4-2 reflects the complex pattern of fine sediment transport within the estuary. In some parts of the estuary, the dominant pathway is up-estuary, whilst between Newport and Barry, down-estuary transport appears to be dominant. As the study area is located within this section, this indicates that fine sediment entering (re-) circulation in the vicinity of the Rhymney River confluence could be transported alongshore in either direction, but possibly predominantly down-estuary. Meanwhile, coarser sediment is most likely to be transported up-estuary.

4.2.12 Although the sediment budget of the Severn Estuary is difficult to quantify, there appears to be little contemporary input or output of sediments in the estuary and the existing material is being reworked continuously. Table 4-4 presents an overview of the estimated sediment sources and sinks within the estuary. Fluvial sediment supply is shown to be the greatest contemporary sediment input, whilst continuous mudflat erosion is the largest input overall. However, mudflats also act as a massive sink within the system. The review shows that sources are estimated to be greater than sinks, so the estuary is assumed to be a net exporter of sediment (ABPmer 2006). Suspended sediment loads are extremely high, estimated to be 30 million tonnes on a spring tide (Atkins 2010). Locally, turbidity monitoring in the Cardiff Grounds showed very high suspended sediment concentrations of 23,000mg/l, at which point the sensor was buried (Titan Environmental Surveys Ltd, 2016). Cardiff Grounds is a disposal point for dredged material, with an average of 650,000 tonnes deposited per annum between 2009 and 2019 mainly from maintenance dredging. It is considered to be a dispersive

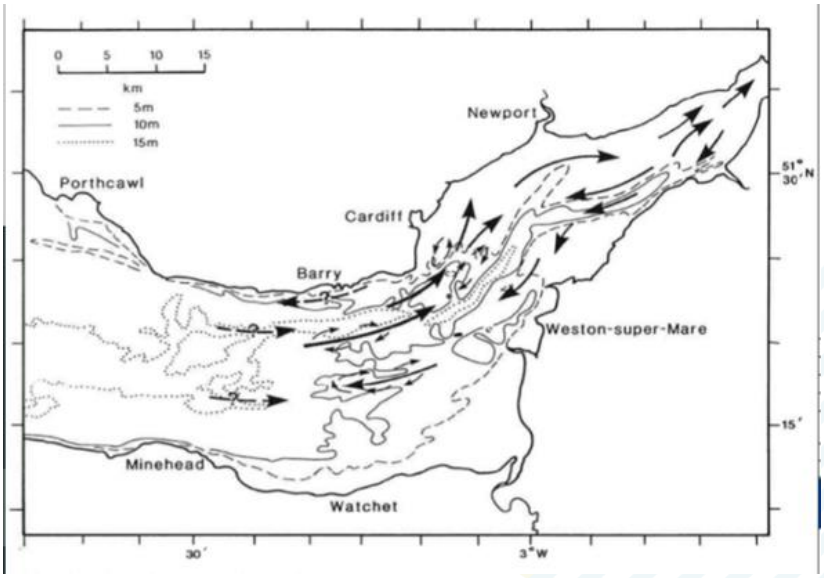



**Figure 4-1: Conceptualised pattern of sand circulation (from Kirby and Parker 1982)**

disposal point due to the dynamic coastal processes, which shift deposited sediment in a general north east direction towards the long-term sinks of the Newport Deeps and River Usk marshes.

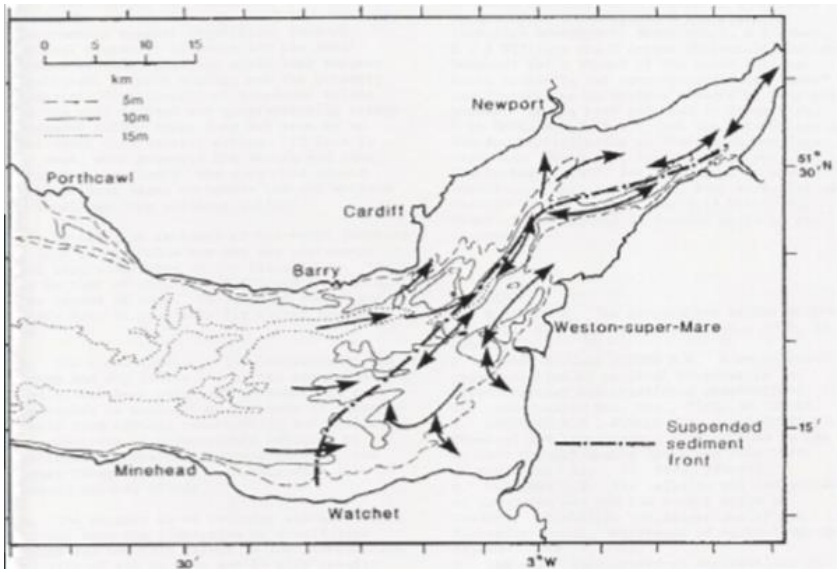



**Figure 4-2: Conceptualised pattern of fine sediment circulation (from Kirby and Parker 1982)**

**Table 4-4: Estimated Severn Estuary sediment budget (from Atkins 2010)**

| Dynamic Status | Element | Description | Rate or Sediment Load | Total |
|---|---|---|---|---|
| Sources | Rivers | Fluvial sediment supply | 1M tonnes/yr | 4.16M to 5.4M tonnes/yr |
| | Cliff | Erosion | 0.06 to 1.3M tonnes/yr | |
| | Saltmarsh | Erosion (horizontal) | 0.1M tonnes/yr | |
| | Mudflat | Erosion | 2.5M tonnes/yr | |
| | Subtidal | Erosion | 0.5M tonnes/yr | |
| Sinks[1] | Saltmarsh (around Bridgwater Bay) | Accretion (vertical) | 0.06M tonnes/yr | 1.06 to 2.06M tonnes/yr |
| | Mudflat (Bridgwater Bay, Peterstone Flat and Newport Deep) | Accretion | 1 to 2M tonnes/yr | |
| Transfers | Water Body | Suspended sediment | Estimates vary from 9-13 tonnes (neap to spring) and 30M tonnes (spring) | 30M tonnes |
| | Anthropogenic Intervention | Aggregate extraction | 1.5M tonnes/yr | 1.5M tonnes/yr |

[1] Sinks estimate is referring to localised areas, the rate of accretion in some areas has not been quantified.

## Estuarine morphology and trends

### Overview

4.2.13 The project sites are located adjacent to the River Rhymney and Cardiff Flats, within the wider setting of the Severn Estuary. This position provides a range of geomorphic scales, within which landform dynamics may actively contribute to observed or projected coastal change (JBA Consulting 2017; Table 4-5). Interaction of the associated landforms with management of the Rover Way and Lamby Way foreshores

is expected to occur (e.g. mudflat retreat caused by change at the Severn Estuary scale will affect coastal management). In general, there is a relationship between temporal and spatial scales, which supports the identification of the key processes (e.g. larger-scale morphodynamics are strongly linked to longer-term environmental change); however, this concept may provide a limited basis for process attribution in situations where the coast is highly perturbed, which may include storm response, construction of major works, or sea level rise. In the following sections, the characterising geomorphology of units at the scale of the Severn Estuary, Cardiff/Wentlooge Foreshores and the River Rhymney will be discussed, in the context of their interaction with other geomorphic units within the Severn Estuary and nested smaller-scale units listed in Table 4-5.

**Table 4-5: Classification of geomorphic units by scale**

| Feature | Scale | Geomorphic Classification |
|---|---|---|
| *Severn Estuary* | | |
| Severn Estuary | ~100 km | Large-scale tidal estuary |
| Severn Central | ~20 km | Tidal estuary basin |
| Taff - Usk Floodplain | ~15 km | Alluvial floodplain |
| Cardiff Foreshore (PU2) | ~2 km | Made ground |
| Wentlooge Foreshore (PU3) | ~2 km | Reclaimed wetland |
| *River Rhymney* | | |
| Sub-tidal | ~2.2 km x 50m | Inter-tidal channel |
| Meanders | ~2.5km x 40m | Tidal channel meander |
| Channel | 15m width | Riverine channel |
| Cardiff Flats / Wentlooge Levels | ~1 km | Inter-tidal flats |
| Tidal Channels | ~1-10 m | Tidal channels |
| Outfall / drain channels | ~1-4 m | Drainage channels |
| Beaches | ~40 m | Sand-gravel Beaches |
| River banks | ~20 m | Mud-sand Banks |
| Foreshore structures | ~10 m | Walling |
| Structure sub-scales | ~1-5 m | Walling components |

### Severn Estuary

4.2.14 The outer and central Severn Estuary has formed within a geological basin of folded and faulted lower Jurassic mudstones and limestones, overlying Silurian bedrock. This basin is overlain with Quaternary sediments, which have been subject to extensive reworking due to glacial and interglacial sea level fluctuations. Relatively small sediment contributions occur from erosion of rock features and alluvial input from the Severn, Taff, Usk and Rye Rivers; however, the predominant input has estuarine origin, being silts and muds.

4.2.15 Very strong tidal currents within the estuary provide a mechanism for sediment sorting,

supporting the formation of seabed features that are mainly comprised of gravels, sands or muds. This has a general transition from muddy (upstream) to coarse deposits (towards the estuary mouth). Complexity is introduced by local flow controls, including geological formations such as headlands and islands, along with the estuary 'banks'. These controls have supported development and preservation of discrete sedimentary features, including remnant floodplains formed during eras of different sea level. Floodplain material retained between sea level phases has produced stratigraphic sequences which are variously expressed along the Severn Estuary coast.

4.2.16 The Wentlooge Formation is the major coastal sedimentary feature in the vicinity of Cardiff, comprised of greenish-grey slightly silty clays, which were deposited during the late Holocene  Marine transgression (from 11,000 years ago). This is occasionally interspersed with peat, and commonly crested by a smaller feature, termed the Rumney Formation, which is comprised of pink estuarine silty clays, mainly deposited since the late Medieval period, following construction of extensive drainage and sea defences which altered the floodplain hydraulics (JBA Consulting 2017).

4.2.17 The tidal limit of the Severn is approximated to be at Maisemore and Llanthony weirs, near Gloucester, whilst the downstream limit is between the headland at Lavernock Point and Brean Down. The estuary is 15km wide towards the mouth, but narrows to <60m wide inland near Gloucester. The estuary is funnel-shaped, which increasingly constricts the incoming tide, increasing tidal amplitudes and causing high current velocities. As the estuary narrows, it becomes less exposed to Atlantic swell waves, instead the influence of tidal currents and river processes start to dominate.

4.2.18 According the SMP2 (Atkins 2010), the major morphological components of the Severn Estuary are:

- Rocky intertidal platforms covered with a thin layer of sediment;
- Major sand deposits and sandbanks in the central parts of the estuary;
- Subtidal channels, with gravel and sand or mud deposits;
- Muddy tributary estuaries;
- Muddy intertidal foreshores with relatively limited saltmarsh;
- Sand beaches and dunes on the Atlantic facing coast;
- Shingle beaches.

4.2.19 The main morphological components found within the study area are: (a) muddy tributary estuaries; and (b) muddy intertidal foreshores with relatively limited saltmarsh. The estuary fringe is naturally dominated by wide expanses of intertidal mudflats and former floodplains ('levels'). These morphological components have been severely degraded and reduced in size and function by historic and current human modification in the form of reclamation, flood defence construction, urbanisation, industrialisation and the planting of Spartina. Both high and low water marks have moved landwards over most of the shoreline, indicating a net erosion trend. Intertidal habitat erosion and accretion rates are spatially variable. However, the dominant trend within the estuary seems to be one of erosion, which will be exacerbated by sea level rise as the future morphological evolution of the estuary is constrained by physical human barriers, as well as natural geological formations and sediment availability.

### Cardiff/Wentlooge foreshore

4.2.20 Although the study area lies within the Cardiff Bay SMP2 policy units, the Wentlooge

SMP2 policy units are adjacent and linked to the Cardiff Bay units through alongshore processes (Atkins 2010). The Cardiff Bay SMP2 units (PU2) cover Penarth Head in the south to Cardiff Flats in the north, including Cardiff Bay Barrage. A large proportion of the shoreline is reclaimed as a result of industrialisation and port construction. Prior to the construction of Cardiff Bay Barrage in 1999, the bay was comprised of large amounts of mudflat and some saltmarsh. The Wentlooge units (PU3) cover Cardiff Flats in the south to the western bank of the Usk. Within these units, a large expanse of gently sloping mudflat extends <2km from the shoreline.

4.2.21 Within the study area, the mudflat is backed by a narrow, steep bank (the 'beach') mostly comprised of debris, bioproduction and lag deposits (JBA Consulting 2017b; Figure 4-3). The morphology of the beach is controlled by waves and water levels, with waves highly dissipated by the fronting mudflat. Historically, this area would have been saltmarsh and subject to highly different coastal processes, similar to the expanse of saltmarsh to the north-east at Peterstone. However, land reclamation, coastal squeeze and resulting erosional pressures have reduced saltmarsh habitat into small isolated patches, such as behind the 'beach' ridge and fragments at the mouth of the Rhymney River. The coastline therefore appears to be erosional in the modern day, with the reclaimed land contributing a large amount of unnaturally coarse material into the system. A coastal processes impact assessment by JBA Consulting (2021a) describes how this coarse sediment enables a steep slope, which could already be impacting the local mudflat morphology through partial wave reflection. This material is occasionally transported onto the mudflat via progressive erosion (JBA Consulting 2017a). The wide expanse of intertidal mudflat tends to dissipate wave energy, reducing the potential for coarse sediment transport within the local area. However, occasional storm events transport coarse material from the 'beach' onto the mudflat. The coarse material is not transported far alongshore, as velocities are generally too low to transport larger material once normal conditions resume. This material is either buried within the mudflat or is transported landwards by cross-shore processes. As future sea levels rise and the dissipative mudflat narrows, higher velocities may increase the potential for coarse sediment transport both along and cross-shore, predominantly in an easterly direction. However, erosion of the coastline is not deemed to be a significant source of fine sediment in this location (JBA Consulting 2021a).

**Figure 4-3: Steep ridge to the west of the River Rhymney, containing coarse waste materials**

4.2.22 In the SMP2 (Atkins 2010), it describes how MLW has retreated across the whole of the Wentlooge units (including the study area), the intertidal zone has decreased in width and foreshore lowering has taken place. However, rates of change are spatially

variable, with some parts of the foreshore eroding, whilst others are accreting. Studies have shown that coastal erosion is taking place along the Wentlooge and Rumney coast, whilst the Peterstone coast to the northeast is accreting. OS maps indicate that south of Rumney Great Wharf (including the study area), the foreshore is eroding at 2.1m per year, whilst to the north this drops to 1.3m per year and then at Peterstone Great Wharf the foreshore is accreting at 0.4m per year. In addition, vertical mudbank lowering (0.03-0.04 m/yr) has been reported through analysis of discrete profile measurements, including observations from 1987, 2000 and 2006, along with construction profiles at Rumney Valley Sewer outfall and the Y&P sewer outfall (HR Wallingford 2016).

4.2.23 The long-term trend (since 1900) within the study area does appear to be erosional. Intertidal habitats within the estuary and the local study area have been substantially modified historically, since the Roman times. This is evident when comparing historic maps with the present day. In maps from 1900, the entirety of the foreshore within the study area was fringed by wide expanses of saltmarsh, but this habitat progressively reduces in area over the years as a result of substantial land reclamation. In 1965 maps, some saltmarsh remains within the study area, but in the last ~50 years, most of the intertidal habitat was reclaimed and remaining degraded fragments on the foreshore would have been eroded, possibly as a result of scour at the toe of the steep slope at the boundary of the reclaimed land. In addition, large areas of intertidal habitat have been progressively reclaimed to the west of the study area since 1900, which is likely to have altered alongshore coastal processes. Flood defences are present in a number of places on the Cardiff frontage and within the Wentlooge Unit. Within the study area, degraded gabion baskets are present next to Frag Tip and remnant rock armour lines the frontage adjacent to the Lamby Way Landfill.

### River Rhymney

4.2.24 As the River Rhymney is tidal up to the weir adjacent to Rumney Rugby Football Club, the study area is dominated by tidal processes and estuarine morphology. The banks are composed of fine, cohesive sediments, forming intertidal mudflats, sloping upwards into narrow strips and fragments of saltmarsh in some higher elevated areas. Coarser sediment and some fine sediment has been deposited in the middle of the channel bed in some places, leading to the formation of mid-channel bar features. The sediment supply is not lacking within the study area, as substantial amounts of fine sediment are carried in suspension within the Severn Estuary, and fluvial inputs are a significant contemporary source. This is reflected by the presence of stable, convex mudflat profiles in some limited straighter sections and deposition on the channel bed (Figure 4-4).

**Figure 4-4: Stable mudflat**

4.2.25 The banks are generally shallower in gradient on the inside of meanders, and steeper on the outside. This would be the case naturally, but physical modification and confinement of the estuarine tributary has caused the banks to oversteepen in a number of places. Due to the steepness of the bank, consolidated material has slumped down, exposing the upper bank profile and making it vulnerable to erosion (scour) during high flows. The slumped material has been eroded away. In a previous assessment by JBA Consulting (2017a), hydraulic modelling results indicated that erosion of silts and sands towards the outer bend of the channel is likely, given that velocities are highest in these regions. Water from the falling tide is forced against the right-hand bank near Lamby Way/ Rover Way, enabling erosional processes to develop. CFD modelling has also been conducted, where the design flow event (206m³/s) was simulated using an unsteady state hydraulic model with a downstream falling tide boundary condition. This showed that on the outside banks of the meanders within the study area, shear stress values for the entrainment of fine sediment are generally exceeded below 3mAOD, whilst velocities are shown to be lower above this level (JBA Consulting, 2021b)

4.2.26 Historical maps of the River Rhymney date back to the 1880s. They show that whilst the river mouth has remained relatively fixed in its current position over the last 140 years, the river planform and length has altered. Some of this change is the result of natural hydromorphic processes; however, the rest is due to physical modification. As recently as the 1970s, an additional meander is shown on historical maps downstream of the railway line (Figure 4-5). Between 1975 and 1982, this bend was removed and the Lamby Way road constructed directly across the river, resulting in a reduction in channel length of approximately 1.2km and constriction of river flow under the road bridge. By 1995 the cut-off channel visible following road and bridge construction, is absent from the historic maps and the land southeast of Lamby Way has been taken over by a landfill site. This physical modification and shortening of the flow path and corresponding steepening of the gradient along the Rhymney River, has triggered a reach-scale response in which increased velocities have contributed to bank instability (JBA Consulting 2019).

4.2.27 As mentioned above, some of the channel change evident from the historical map analysis is the result of natural hydromorphic processes. For instance, prior to the physical modification in the 1970s, a migratory trend towards the south-east is shown on the former meander at NGR 321810 178450 (Figure 4-5). Equally at the meander towards the estuary mouth there is some shift in the planform towards the east. These

shifts are the result of erosional and depositional processes that led to lateral migration of the river. This indicates the river has the potential to migrate, as would be expected in an estuarine system. However, physical modifications of the channel have also exacerbated channel change. Land-use changes, such as the construction on the tip on the northern floodplain and development of infrastructure on the southern floodplain have affected the whole estuarine network, changing the local drainage and hydrology of the system. Confinement of the channel exacerbates squeeze of the intertidal banks. Where there is no space for the habitat to rollover landward, the only response to higher velocities within the channel and future increases in sea level is for the intertidal banks to erode, steepen and narrow.

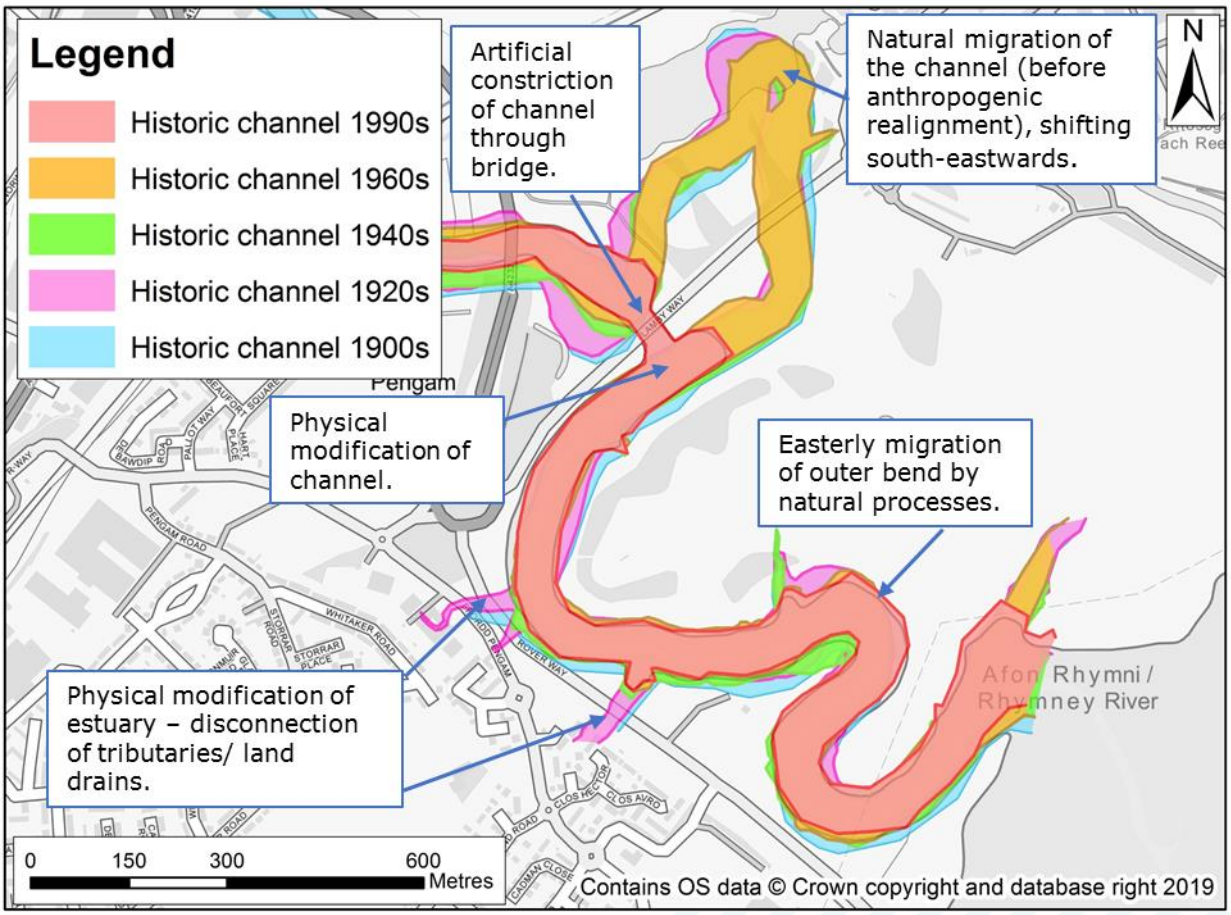



**Figure 4-5: Historical channel change (from JBA Consulting 2019)**

4.2.28 Figure 4-6 shows the sections of channel subject to erosional processes. The numbered points below relate to the numbered stars in Figure 4-6, highlighting key points of morphological interest, identified during a site visit (JBA Consulting 2019) and investigation of historical maps/aerial imagery):

(1) Former entrance of a meander that was removed in the 1970s. After the meander was removed, the thalweg shifted to the left bank (either re-routed or naturally eroded). Left bank erosion is occurring, and the vegetated intertidal area has retreated since the early 2000s and is generally extremely narrow. The former thalweg on the inside of the meander has accreted and appears to be depositional, appearing to be a convex profile transitioning from lower to upper saltmarsh (see Figure 4-4).

(2) Truncated meander exit – potentially slowly infilling with sediment. The vegetated area has increased as a result. Following truncation, the creek has filled with sediment on the flood tide, but reduced tidal currents on the ebb in the lee of the truncated exit will not necessarily be enough to re-entrain the deposited sediment, causing accretion.

(3) Former creek/drain outfall. Evidence of accretion. Large expanse of mudflat transitioning into saltmarsh, possibly convex cross section. The vegetated intertidal area has increased since the early 2000s and 2018 imagery shows a large amount of sediment building up in the channel. This could be due to a combination of its location on the inside of the new meander which is developing, possible increases in sediment supply and historic changes to the system and the subsequent natural reaction and readjustment. Cutting off the meander in the 1970s will have caused a big reduction in tidal prism, which may be causing sediment accumulation in some places. Sediment is deposited on the flood tide, but the ebb is not strong enough to re-entrain on the lee of the meander.

(4) Former creek / drain outfall. Erosion of the intertidal area is occurring. The channel appears to be naturally forming a new meander, as deposition on the right side of the channel is forcing the thalweg towards the left bank. This was the location of a former creek/drain outfall where the intertidal area has always been narrow. Higher current velocities are preventing significant deposition on the intertidal flats and there is little existing dissipating vegetation in place to slow erosion. A positive feedback process is occurring, as the channel is starting to shift landward of the left bank.

(5) Former creek/drain outfall. The meander is shifting towards the right bank. It has moved considerably since 1965 and has moved a reasonable amount since the early 2000s. The inside of the meander is accreting and the area of intertidal vegetation has increased, whilst the outside of the meander has eroded, moving closer to the adjacent road. Slightly downstream, the intertidal area on the inside of the meander is much narrower, possibly as flows reflect from the steep, meander bend onto the opposite side of the channel or possibly due to the constriction of flows following the historic disconnection of tributaries.

(6) & (7) The meander has shifted towards the left bank since 1965. In the last 50 years, a sailing club has been developed on the inside of the meander, where mudflats previously dominated. However, in the years since 1965, it has been assumed that the land on the inside of the meander has been expanded and raised for the development of the sailing club, which has caused flows to shift back into the centre of the channel. There is evidence that rapid erosion of the intertidal area to the south-east (7) has occurred during the 2000s, which would align with the general direction of movement of the meander throughout the 1900s. This migration process is narrowing the inside of the meander at the mouth of the tributary, and is likely to cut it off in the near future to create an island feature. The intertidal area at the outer point of the meander is showing some signs of slumping, as is the upstream bank of the sailing club (6). The stabilisation of the inside of the meander is likely to have exacerbated slumping of the banks in these locations, as ebbing flows erode the upstream bank of the sailing club (6) and then are reflected to the outside of the meander. However, recession of the intertidal area at these locations does not appear to be occurring as rapidly as the south-eastern section of the meander. Erosion at these slumping locations would be alleviated if the inside of the meander was permitted to migrate naturally.

(8) Scour is occurring on the outside of the meander and the intertidal mudflat is oversteepened and narrow due to confinement by the adjacent road and an existing sheet pile in the landward embankment. A relatively large expanse of saltmarsh is adjacent to the meander, at the mouth of the River Rhymney. This was historically connected to larger areas of fringing saltmarsh on the Severn foreshore, but is now the only remaining fragment within the study area.

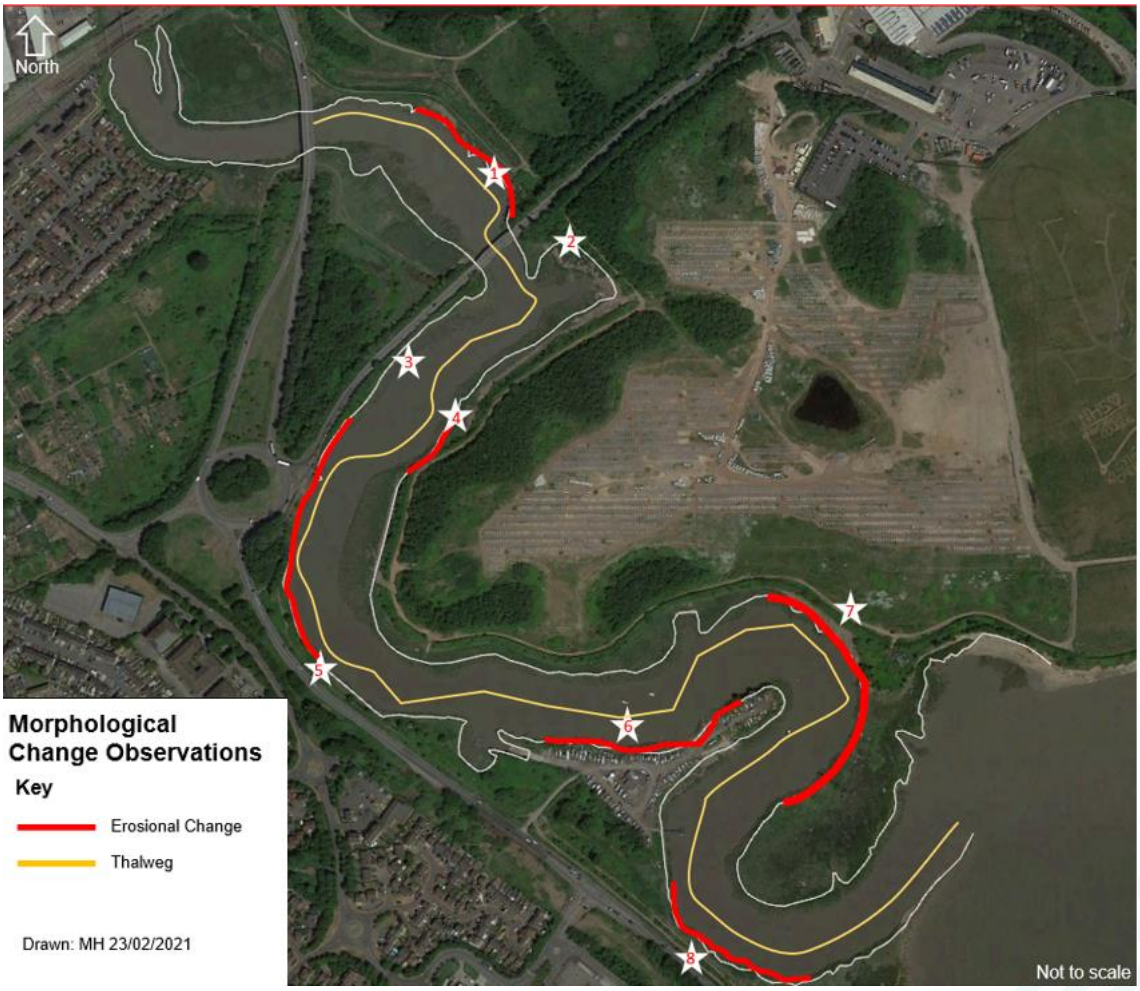



**Figure 4-6: Key areas of morphological change**

4.2.29 The River Rhymney tidal catchment (up to the weir) is relatively small and there are no substantial increases of tidal inundation under moderate sea level rise scenarios. Consequently, projected sea level rise is estimated to cause a small change in tidal prism and a moderate change to channel cross-section. This creates an increased tendency for sedimentation, due to the limited fluvial sediment input. This may create a small potential for near-field erosion, with material moving from the banks towards the base of the channel. Material feed from the channel entrance (i.e. mudbank and adjacent coast) is expected to be low, although this can produce additional erosion pressure in the immediate vicinity (JBA Consulting 2017).

## 4.3 Assessment Methodology and Significance Criteria

### Assessment methodology

4.3.1 This assessment considers the potential short-term (construction) and long-term (operational) impacts of the proposals on the local and regional coastal processes.

4.3.2 The assessment of the coastal processes and geomorphology has been undertaken as a desk-based assessment utilising the following sources:

- Existing literature, including Shoreline Management Plans, previous geomorphology and coastal process assessments by JBA Consulting as part of the OBC (2017) and

detailed design (2019, 2021), flood and erosion reports, scientific papers on Severn Estuary hydromorphic functioning;

- Remote assessment via site visits, aerial imagery and LiDAR imagery;
- Historical maps (https://maps.nls.uk/);
- Extreme sea level data from the Environment Agency (2018);
- Sea level rise predictions based on UKCP18 scenarios from Natural Resources Wales (2021).

4.3.3 In accordance with the definitions of impacts provided in Table 4-8 activities have been assessed with regards to their potential to impact on coastal processes; namely, direct impacts on hydrodynamics and sediment transport and indirect geomorphological impact on intertidal habitat. The potential for direct impacts on designated ecological features, in their own right, is considered in Section 5.

4.3.4 The consequences of these impacts have been assessed with regards to the scale at which they naturally operate in accordance with the sensitivity criteria provided in Table 4-9. Table 4-8 has then been used in order to determine the significance of the effect on scheme proposals. Where the consequences of the changes in coastal processes would impact on specific environmental receptors of value (i.e. ecological receptors), these are addressed as secondary effects in the relevant section of the ES.

**Table 4-6: Criteria for defining the magnitude of impacts on coastal processes**

| Impact score | Criteria |
|---|---|
| **Major** | Major change in the strength of magnitude of the process operating. |
| **Moderate** | Moderate change in the strength of magnitude of the process operating. |
| **Minor** | Minor change in the strength of magnitude of the process operating. |
| **Negligible or no change** | No perceptible change in the strength of magnitude of the process operating. |

**Table 4-7: Criteria for defining the sensitivity of coastal processes**

| Sensitivity score | Criteria |
|---|---|
| **High** | Coastal processes operating at the scale of the Severn Estuary. |
| **Medium** | Coastal processes operating at the scale of Cardiff/Wentlooge SMP2 management units (PU2/PU3) |
| **Low** | Coastal processes operating at the scale of the site or limited to the immediate nearshore zone. |

## 4.4 Potential Impacts and Significant Effects

### Section 1a and 1b

***Construction Impacts***

4.4.1 During construction, the materials will be delivered to the intertidal area via an access route on the embankment. No materials, including excavated sediment, will be stored on the foreshore. Therefore, it is considered that there will be No Significant Effect on the hydrodynamic regime during construction.

4.4.2 There is a limited risk that excavation during construction could mobilise beach sediment into the sea. Tidal sediments will be tested for contaminants during the GI

phase. Assuming any contaminants present are below acceptable contamination levels, uncontaminated excess material will be reinstated at the toe of the rock armour to allow redispersal into the active marine environment. The rock revetment will be constructed from toe to crest in sections that can be completed during a single tidal period. For the construction of each section (expected to be approximately 20-40m sections), only about 100-200m3 of sediment material is likely to be excavated each day. Considering that suspended sediment concentrations on a spring tide within the Severn Estuary are estimated at 30 million tonnes and the coastal zone is highly dispersive (hence its use as a dredging disposal point), it is unlikely that significant volumes of sediment will be mobilised at any time during construction and the coastal processes are considered as low sensitivity. A geotextile membrane will also underlie the rock armour, which will reduce erosion at the toe and base of the revetment and prevent leaching of underlying substrate. There will be no movement of construction vehicles on the foreshore, as the proposed defences will be constructed using access routes on the embankment. As a result, it is considered that there will be No Significant Effect on the sediment regime during construction.

***Operational impacts***

4.4.3 The proposed defence will be wetted during every high tide at current sea level, but at MHWN the tide will only touch the toe of the defence, whilst MHWS covers the lower third of the defence. This is similar to the inundation frequency of the existing coarse 'beach'. However, wave reflection could be increased during storm events. The proposed defence will not be inundated for the majority of each tidal cycle and the slope of the proposed revetment is not exceedingly steeper than the existing slope of coarse sediment, having been designed to dissipate wave energy to reduce the impact of scour at the toe, which will reduce rapid erosion of the intertidal flat. With sea level rise, the defence will be inundated more frequently and at greater depths, and storm events will be more frequent. This could have the potential to accentuate scour of the mudflat, as the hard-engineered coastal defence prevents land from rolling over to accommodate a greater tidal prism. This could also contribute to the wider problem of coastal squeeze within the estuary. However, these impacts are low sensitivity within the context of the Severn Estuary, representing a negligible impact on the overall tidal prism. The overall tidal prism of the Severn Estuary has been calculated at approximately 96 x 108 m3 within the SMP (Atkins 2010); therefore, given that the footprint of the proposed defence is 33,727m2, it is considered that the operation of the proposed defence will have No Significant Effect on the local or wider hydrodynamic regime.

4.4.4 As the proposed defence will not be inundated for the majority of each tidal cycle and the slope of the proposed revetment has been designed to dissipate wave energy, release of sediment from short-term scour of the mudflat is unlikely to be significant in volume. In addition, a geotextile will be placed under the rock armour to prevent sediment washout. The proposed defence is therefore unlikely to greatly impact the local transport of sediment or cause sediment plumes. The historic replacement of fringing saltmarsh with reclaimed land has already increased wave energy at the coastal boundary and is likely to be contributing to the erosion and progressive lowering of the neighbouring mudflat habitat; therefore it is likely that the mudflat is already in the process of adjusting its morphology to artificially higher energy conditions within the area and mudflat scour may be further stabilised by the formation of a 'mixed sediment zone' at the toe of the proposed revetment. Therefore, due to the low sensitivity of the coastal processes and the minor impact score, it is considered that the operation of the proposed defence will have No Significant Effect on the local or wider sediment regime in the estuary.

4.4.5 The reclaimed land protected by the revetment will no longer be a sediment source to

the estuary, potentially depleting the amount of sediment available for alongshore transfer to intertidal flats along the coast. However, as discussed above, the scale of the defences within the Severn Estuary is extremely minimal, representing a negligible impact on the overall sediment budget. In addition, as the reclaimed land is made ground, consisting of significant amounts of coarse landfill and spoil material, it is not contributing a significant amount of fine sediment into the system. The coarse material is mobilised only during storm events, spreading locally across the mudflat. It is then either buried within the mudflat or transported back landwards. Limited amounts of sands and muds may re-enter circulation during storm events when progressive erosion occurs, but erosion of the reclaimed land is not a major source of fine sediment within the estuary. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the proposed defence will have No Significant Effect on intertidal habitats within the estuary, through indirect geomorphological processes.

### Section 2a and 2b

***Construction impacts***

4.4.6 The embankments in these sections are to be constructed in the place of existing earth embankment flood defences. This will be above the current HAT level; therefore, construction of the proposed defence will not impact hydrodynamics within the River Rhymney. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the construction of the defence will have No Significant Effect on the local hydrodynamic regime.

4.4.7 There is a limited risk that placement of sediment on the embankment may cause sediment washout into the estuary during high rainfall events. As the embankment will be above the current HAT level, the risk of tidal mobilisation is low. The embankment is set back from the estuary and the small volume of sediment that could be washed into the estuary is insignificant in context of the high suspended sediment loads within the Severn Estuary. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, No Significant Effect on the sediment regime is anticipated.

4.4.8 As the embankment will be constructed above the current HAT level and there are considered to be no potential significant effects on the sediment regime, there are unlikely to be any indirect geomorphological impacts on intertidal habitats during construction. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the construction of the defence will have No Significant Effect on intertidal habitat within the estuary, through indirect geomorphological processes.

***Operational impacts***

4.4.9 The embankment will be built above the current HAT level; therefore, it will initially only be inundated during extreme water levels. As the embankment will not be inundated during most tidal cycles, it is considered that hydrodynamics within the estuary will not be impacted by the embankment. In addition, wave activity within the River Rhymney is very limited, so wave reflection is unlikely to be a risk during extreme water level events. The maintained embankment will restrict the migration of the meander, so the outside of the meander is likely to steepen further over time. Although interaction with hard defences can often alter local hydrodynamics (e.g. tidal currents), this future scenario is not considered to be significantly different from the status quo, as an embankment is already in place. Fixing the meander in place will mean that estuary will have a reduced response to accommodating a greater tidal prism

associated with sea level rise. However, the meander has been fixed in place for a significant amount of time due to the assets adjacent to the eroding bank and the proposed works therefore do not represent a significant reduction in accommodation space in comparison with the present day. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on hydrodynamics within the estuary.

4.4.10 The proposed embankment will be built above the current HAT level; therefore, it will not be interacting with the channel banks. Therefore, it is considered that the operation of the defence will have No Significant Effect on the sediment regime in the Rhymney or the wider estuary.

4.4.11 As discussed above, the embankment will not be inundated during most tidal cycles; therefore, it is considered that hydrodynamics within the estuary will not be impacted by the embankment. In addition, wave activity within the River Rhymney is very limited, so wave reflection is unlikely to be a risk during extreme water level events. Therefore, the mudflat and adjacent saltmarsh habitat is unlikely to be indirectly impacted by reflected waves and currents following the proposed works. As the meander continues to migrate and sea levels rise, the intertidal mudflat on the channel bank is expected to further oversteepen and narrow as a result of coastal squeeze. However, the meander bend has been fixed in position for many years and the proposed maintenance will not impact intertidal habitat more than in the current scenario. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on the intertidal habitat in the Rhymney or the wider estuary, through indirect geomorphological processes.

### Sections 3a and 3b

#### *Construction impacts*

4.4.12 The Dycel Block scour protection is to be located between below MLW and HAT. With the exception of the works below MLW, the majority of works will be conducted under dry conditions (i.e. when tide levels expose the work areas). The length of the tidal cycle and therefore the working window would vary depending on the level of the astronomical tide. There will be no storage of materials on the foreshore. Therefore, it is considered that the construction of the defence will have No Significant Impact on hydrodynamics in the Rhymney and the wider estuary.

4.4.13 Excavation for the rock armour toe will take place below mean low water. Excavation could therefore cause sedimentation mobilisation within the River Rhymney. Construction machinery will be restricted to the top of the embankment and the constructed 'bench' within the scour protection, reducing the potential of sediment mobilisation or compaction on the foreshore.

4.4.14 The rock armour and Dycel blocks will be underlain by a geotextile to reduce sediment washout following excavation.

4.4.15 The rock revetment will be constructed from toe to crest in short sections (20-40m in length) that can be completed during a single tidal period. For the construction of each section, approximately 100-200m3 of sediment is likely to be excavated and temporarily stored outside of the intertidal area before being reinstated on the defence. Any resulting sediment mobilisation during excavation is considered to be fairly minor

in the context of large suspended sediment loads within the Severn Estuary (approximately 30 million tonnes on a spring tide) and highly unlikely to cause permanent or temporary sediment plumes. In addition, the coastal zone is highly dispersive in this area, hence the use of Cardiff Grounds as a dredging disposal site. Therefore, it is considered that the construction of the defence will have No Significant Impact on the sediment regime of the River Rhymney and the wider Severn Estuary.

4.4.16 As no significant impacts on hydrodynamics and the sediment regime are considered likely, it is also considered that the construction of the defence will have No Significant Impact on intertidal habitat through indirect geomorphological processes.

***Operational impacts***

4.4.17 The proposed revetment at section 3a will replace the existing mudflat and saltmarsh habitat on the foreshore, between below MLW and HAT. Therefore, the revetment will be inundated for almost the entirety of every tidal cycle. Wave action is very limited within the River Rhymney; therefore, wave reflection is unlikely to be a great risk in this part of the estuary. The revetment will replace soft, dissipative mud and saltmarsh vegetation with hard materials, which could increase the reflection of tidal currents back into the channel, onto other areas of intertidal habitat, or onto the opposite bank, which may cause a requirement for future erosion protection. However, the proposed revetment mimics the existing gradient of the banks and is a lower gradient in many locations. The strategic placing of timber stakes and brushwood packing in combination with coir matting between MHWN and HAT will roughen the surface and reduce local velocities, which are more likely to encourage sediment and seed deposition. These measures aim to create a more natural, vegetated, dissipative surface in comparison with a vertical, hard surface. The proposed defence is unlikely to impact the dominant flow direction, as currents are already rebounding off the steepening bank and sheet piles are already in place in the bank at section 3a, which appear to be contributing to slight narrowing of the intertidal zone on the inside as well as the outside of the meander, possibly due to current reflection on the ebb tide. The new, gentle gradient of the slope and natural design of the upper half of the proposed defence will greatly reduce the risk of current reflection, but any minor increases in reflection that could result from section 3a are unlikely to impact depositional intertidal habitat on the opposite side of the bank. Installing sheet piles at the top of the bank of sections 3a and 3b will fix these sections in place, potentially causing the estuary to have a reduced response to accommodating a greater tidal prism associated with sea level rise. However, section 3a is eroding at a fairly rapid rate and the intertidal habitat is steep and narrow in this section, with little potential to accommodate an increasing tidal prism, due to the use of the adjacent land as a large road. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on hydrodynamics within the River Rhymney or the wider Severn Estuary.

4.4.18 The Dycel Block scour protection at section 3a will cut off the existing intertidal bank from the sediment budget of the Severn Estuary. However, at less than 300m in length, this section represents a negligible contribution to the overall suspended sediment load of the Severn Estuary (approximately 30 million tonnes on a spring tide). The effect of the proposed revetments on the sediment budget of the Rhymney and Severn is thought to be negligible. In section 3a, excavated mud is to be deposited between MHWN and MHWS. The placed mud will not be consolidated as it has not settled out of suspension to form a mudflat via natural processes. Therefore, it is proposed to cover the deposited mud with biodegradable coir matting, which will allow slow re-consolidation within its lifespan of approximately 3-5 years. Although it is reasonably

high in the tidal frame, the upper section will be inundated by every high tide. Both numerical and conceptual modelling indicate that the outsides of the meander bends in the Rhymney are erosional and have been eroding rapidly historically and in recent years. Hydraulic modelling results indicated that erosion of silts and sands towards the outer bend of the channel is likely, given that velocities are highest in these regions. CFD modelling indicates that scour risk is higher at the toe to mid-defence, which is why the Dycel blocks are to remain exposed in this location. Although this modelling indicates that shear stresses are lower on the upper half of the revetment, coir matting and strategically placed brushwood packing between MHWN and HAT will maximise the effectiveness of the design to greatly reduce the risk of widescale sediment mobilisation and increase deposition rates above MHWN to create a functioning intertidal area. Similar approaches have been shown to be successful at other sites. For example, densely arranged brushwood packing has promoted rapid accretion of the bank on the River Usk, as shown in Figure 4-7 where only the tops of the timber stakes now remain visible. Similarly, timber fascines and brushwood packing were installed on two migrating meander bends where assets were at risk on Dartford Creek (Estuary Edges 2021)). Here metal wire was used in conjunction with the brushwood to act as a sediment retention measure. The brushwood has been effective at reducing velocities and promoting sediment deposition to overcome meander migration. In addition, saltmarsh has established on the gentle intertidal slope, with no cliffing as observed prior to the construction of the defence. In some areas, the metal wire has been exposed, and is an environmental hazard and as such it is not proposed in this scheme. Instead, coir matting is proposed on the Rhymney which will biodegrade within approximately 5 years, avoiding future environmental issues whilst allowing the deposited sediment to begin to re-consolidate and roughening the intertidal surface to promote further sediment/seed deposition.

4.4.19 As the revetment is being constructed section-by-section, any remaining sediment mobilisation in relation to the total suspended sediment load of the Severn Estuary (approximately 30 million tonnes on a spring tide) would be negligible. Furthermore, the coastal zone is highly dispersive (hence its use as a dredging disposal site) so any sediment mobilised is anticipated to be transported in suspension to other sediment sinks within the estuary. Retention of the excavated mud within the estuary via a controlled method is considered to be a positive effect, as there will be no losses to the sediment budget. Therefore, it is considered that the operation of the defence will have No Significant Effect on the sediment regime within the River Rhymney and the wider Severn Estuary.

**Figure 4-7: Brushwood on the banks of the River Usk**

4.4.20 Mudflat and saltmarsh habitat is unlikely to be indirectly negatively impacted by the minor sediment mobilisation described above, as under baseline conditions sediment within the estuary is constantly being reworked and transported elsewhere, due to the dynamic nature of the water body. Retaining the excavated sediment within the estuary is beneficial (at a very small-scale) to the maintenance of intertidal habitats. As discussed above, fixing both sections in place will mean that the estuary will have a reduced response to sea level rise, by preventing the natural 'roll back' of intertidal habitats. However, at the scale of the Severn Estuary, the section of revetment at section 3a will not greatly impact accommodation space for future sea level rise, especially as the existing intertidal habitat on the meanders is currently eroding at a fairly rapid rate and it is already steep and narrow in these sections, with little potential to accommodate an increasing tidal prism. At section 3b, the sheet pile will be placed at the top of the bank and will not be inundated for a large portion of the tidal cycle; reducing the potential for current reflection and associated scour of the adjacent intertidal habitat. In addition, wave action is very limited within the River Rhymney; therefore, scour from wave reflection is unlikely to be a great risk to intertidal habitat in this part of the estuary. The adjacent mudflat is currently depositional and this is anticipated to continue in the short-term. In the long-term, as a result of the combined impact of sea level rise and holding the line within the estuary, the intertidal mudflat on the channel bank could become erosional and start to narrow as a result of coastal squeeze. However, section 3b is in a low velocity zone on the inside of the meander and there are signs that the channel is naturally shifting towards the south east as the left bank is eroding. The sheet piles on the right bank are unlikely to cause major changes to this trend. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on intertidal habitat within the River Rhymney or the wider Severn Estuary, through indirect geomorphological processes.

## Section 4

### *Construction impacts*

4.4.22 The Dycel Block scour protection is to be located between below MLW and HAT. With the exception of the works below MLW, the majority of works will be conducted under dry conditions (i.e. when tide levels expose the work areas). The length of the tidal cycle and therefore the working window would vary depending on the level of the astronomical tide. There will be no storage of materials on the foreshore. Therefore, it is considered that the construction of the defence will have No Significant Impact on hydrodynamics in the Rhymney and the wider estuary.

4.4.23 Excavation for the rock armour toe will take place below mean low water. Excavation could therefore cause sedimentation mobilisation within the River Rhymney. Construction machinery will be restricted to the top of the embankment and the constructed 'bench' within the scour protection, reducing the potential of sediment mobilisation or compaction on the foreshore.

4.4.24 The rock armour and Dycel blocks will be underlain by a geotextile to reduce sediment washout following excavation.

4.4.25 The rock revetment will be constructed from toe to crest in short sections that can be completed during a single tidal period. For the construction of each section, 100-200m3 of sediment is estimated to be excavated and temporarily stored outside of the intertidal area before being reinstated on the defence. Any resulting sediment mobilisation during excavation is considered to be fairly minor in the context of large suspended sediment loads within the Severn Estuary (approximately 30 million tonnes on a spring tide) and highly unlikely to cause permanent or temporary sediment plumes. In addition, the coastal zone is highly dispersive in this area, hence the use of Cardiff Grounds as a dredging disposal site. Therefore, it is considered that the construction of the defence will have No Significant Impact on the sediment regime of the River Rhymney and the wider Severn Estuary.

4.4.26 As no significant impacts on hydrodynamics and the sediment regime are considered likely, it is also considered that the construction of the defence will have No Significant Impact on intertidal habitat through indirect geomorphological processes.

### *Operational impacts*

4.4.27 The proposed revetment at section 4 will replace the existing mudflat and saltmarsh habitat on the foreshore, between below MLW and HAT. Therefore, the revetment will be inundated for almost the entirety of every tidal cycle. Wave action is very limited within the River Rhymney; therefore, wave reflection is unlikely to be a great risk in this part of the estuary. The revetment will replace soft, dissipative mud and saltmarsh vegetation with hard materials, which could increase the reflection of tidal currents back into the channel, onto other areas of intertidal habitat, or onto the opposite bank, as has been the problem since the construction of the sailing club. However, the proposed revetment mimics the existing gradient of the banks and is a lower gradient in many locations. The strategic placing of timber stakes and brushwood packing in combination with coir matting between MHWN and HAT will roughen the surface and reduce local velocities, which are more likely to encourage sediment and seed deposition. These measures aim to create a more natural, vegetated, dissipative surface in comparison with a vertical, hard surface. The proposed defence is unlikely to impact the dominant flow direction, as opposite the sailing club, currents are already rebounding off the narrow, oversteepening bank towards the reinforced bank on the

opposite side. Similarly, the location of the proposed upstream revetment within section 4 is already erosional and oversteepened, highly impacted by the direction of the dominant flow path. The new, gentle gradient of the slope and natural design of the upper half of the proposed defence will greatly reduce the risk of current reflection, but any minor increases in reflection that could result from section 4 are unlikely to impact depositional intertidal habitat on the opposite side of the bank. Minor current reflection in the upstream location would be directed towards section 3a, which is already erosional and forms part of the proposed scheme, whilst the downstream location was already historically migrating, until it was reinforced as part of the sailing club development. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on hydrodynamics within the River Rhymney or the wider Severn Estuary.

4.4.28 The Dycel Block scour protection will cut off the existing intertidal bank from the sediment budget of the Severn Estuary. However, with a footprint of 16,145m2 these sections represent a negligible contribution to the overall suspended sediment load of the Severn Estuary. In section 4, excavated mud is to be deposited between MHWN and MHWS. The placed mud will not be consolidated as it has not settled out of suspension to form a mudflat via natural processes. Therefore, it is proposed to cover the deposited mud with biodegradable coir matting, which will allow slow re-consolidation within its lifespan of approximately 3-5 years. Although it is reasonably high in the tidal frame, the upper section will be inundated by every high tide. Both numerical and conceptual modelling indicate that the outsides of the meander bends in the Rhymney are erosional and have been eroding rapidly historically and in recent years. Hydraulic modelling results indicated that erosion of silts and sands towards the outer bend of the channel is likely, given that velocities are highest in these regions. CFD modelling indicates that scour risk is higher at the toe to mid-defence, which is why the Dycel blocks are to remain exposed in this location. Although this modelling indicates that shear stresses are lower on the upper half of the revetment, coir matting and strategically placed brushwood packing between MHWN and HAT will maximise the effectiveness of the design to greatly reduce the risk of widescale sediment mobilisation and increase deposition rates above MHWN to create a functioning intertidal area. As the revetment is being constructed section-by-section, any remaining sediment mobilisation in relation to the total suspended sediment load of the Severn Estuary (approximately 30 million tonnes on a spring tide) would be negligible. Furthermore, the coastal zone is highly dispersive (hence its use as a dredging disposal site) so any sediment mobilised is anticipated to be transported in suspension to other sediment sinks within the estuary. Retention of the excavated mud within the estuary via a controlled method is considered to be a positive effect, as there will be no losses to the sediment budget. Therefore, it is considered that the operation of the defence will have No Significant Effect on the sediment regime within the River Rhymney and the wider Severn Estuary.

4.4.29 Mudflat and saltmarsh habitat is unlikely to be indirectly negatively impacted by the minor sediment mobilisation described above, as under current conditions sediment within the estuary is constantly reworked and transported elsewhere, due to the dynamic nature of the water body. Retaining the excavated sediment within the estuary is beneficial (at a very small-scale) to the maintenance of intertidal habitats. As discussed above, fixing section 4 in place will mean that the estuary will have a reduced response to sea level rise, by preventing the natural 'roll back' of intertidal habitats. However, at the scale of the Severn Estuary, the section of revetment at section 4 will not greatly impact accommodation space for future sea level rise, especially as the existing intertidal habitat on the meanders is currently eroding at a fairly rapid rate and it is steep and narrow in these sections, with little potential to

accommodate an increasing tidal prism. Therefore, due to the low sensitivity of the coastal processes and the minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on intertidal habitat within the River Rhymney or the wider Severn Estuary, through indirect geomorphological processes.

### Section 5

***Construction impacts***

4.4.30 The sheet pile in this section is to be located within the existing earth embankment that is due to be raised as detailed for section 2a. This will be above the current HAT level; therefore, construction of the proposed defence will not impact hydrodynamics within the River Rhymney. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the construction of the defence will have No Significant Effect on the local hydrodynamic regime.

4.4.31 There is a limited risk that excavation for sheet piles may cause sediment washout into the estuary during high rainfall events. As the sheet pile will be above the current HAT level, the risk of tidal mobilisation is low. The embankment is set back from the estuary and the small volume of sediment that could be washed into the estuary is insignificant in context of the high suspended sediment loads within the Severn Estuary. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, No Significant Effect on the sediment regime is anticipated.

4.4.32 As the sheet piling will be constructed above the current HAT level and there are considered to be no potential significant effects on the sediment regime, there are unlikely to be any indirect geomorphological impacts on intertidal habitats during construction. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the construction of the defence will have No Significant Effect on intertidal habitat within the estuary, through indirect geomorphological processes.

***Operational impacts***

4.4.33 The sheet pile wall will be built above the current HAT level; therefore, it will initially only be inundated during extreme water levels. As the sheet pile will not be inundated during most tidal cycles, it is considered that hydrodynamics within the estuary will not be impacted by the embankment. In addition, wave activity within the River Rhymney is very limited, so wave reflection is unlikely to be a risk during extreme water level events. The sheet pile wall will restrict the migration of the meander, so the outside of the meander is likely to steepen further and potentially lead to more frequent inundation of the sheet pile wall. Although interaction with hard defences can often alter local hydrodynamics (e.g. tidal currents), this future scenario is not considered to be significantly different from the status quo, as a sheet pile is already in place in the embankment adjacent to the meander bend, to prevent erosion of Rover Way. The proposed defence is not anticipated to cause changes to the main flow route, as currents already reflect from the eroding meander bend into the mouth of the channel and the sheet pile is to be installed above the current HAT level, only to be inundated during extreme events. Fixing the meander in place will mean that estuary will have a reduced response to accommodating a greater tidal prism associated with sea level rise. However, the meander has been fixed in place for a significant amount of time due to the assets adjacent to the eroding bank and the proposed works therefore do not represent a significant reduction in accommodation space in comparison with the present day. Therefore, due to the low sensitivity of the coastal processes and the

minor impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on hydrodynamics within the estuary.

4.4.34 The proposed sheet pile wall will be built above the current HAT level; therefore, it will not be interacting with the channel banks. The eroding meander will not be cut off as a sediment source following the proposed works. If the meander erodes to the point of the sheet piles in the embankment, as a result of natural migration or sea level rise, sediment inputs from the local area will decrease. However, as there is an existing sheet pile in place, this is not significantly different from the status quo. In addition, the meander bend represents a fairly negligible contribution to the sediment budget of the Severn Estuary (approximately 30 million tonnes on a spring tide) as the length of the section is less than 100m. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on the sediment regime in the Rhymney or the wider estuary.

4.4.35 As discussed above, the sheet pile wall will not be inundated during most tidal cycles; therefore, it is considered that hydrodynamics within the estuary will not be impacted by the embankment. In addition, wave activity within the River Rhymney is very limited, so wave reflection is unlikely to be a risk during extreme water level events. Therefore, the mudflat and adjacent saltmarsh habitat is unlikely to be indirectly impacted by reflected waves and currents following the proposed works. As the meander continues to migrate and sea levels rise, the intertidal mudflat on the channel bank is expected to further oversteepen and narrow as a result of coastal squeeze. The mudflat could disappear if it erodes as far back as the sheet piles in the embankment. However, the meander bend has been fixed in position for many years and the proposed maintenance will not impact intertidal habitat more than in the current scenario. As discussed above, the proposed defence will not alter the dominant flow direction and is unlikely to greatly increase current reflection onto a currently depositional area. Therefore, due to the low sensitivity of the coastal processes and the negligible impact score of the proposals, it is considered that the operation of the defence will have No Significant Effect on the intertidal habitat in the Rhymney or the wider estuary, through indirect geomorphological processes.

## 4.5 Mitigation Measures

### Mitigation measures required for Section 1a and 1b

4.5.1 Potential coastal process impacts would be mitigated through the adoption of good construction practices. As much work as possible will be non-tidal (i.e. undertaken above MHWS or during periods that allow for dry working), and all intertidal works should cease three hours prior to the anticipated high tide time. These practices will eliminate the potential for excavation operations introducing sediment into the water column.

4.5.2 Sediment to be excavated will be tested for contaminants during the GI phase and as long as it is found to be uncontaminated or with low levels of contamination (i.e. within acceptable contamination thresholds), used within the rock armour (if appropriately sized) or reinstated at the toe of the defence to allow for marine dispersal or reintegration into the mixed transitional area between the coarse sediment and mudflats.

4.5.3 All tidal work schedules should be assessed two weeks in advance of the works to avoid storm events. Works will also cease during storm events. These practices will again

assist in reducing the amount of material available for entrainment within the water column.

4.5.4 A UAV survey of the fronting mudflat habitat will be undertaken at the same time of year over a period of five years, to confirm that the presence of the formalised rock armour is not causing a severe impact on mudflat geomorphology; in particular, erosion and sedimentation patterns at the base of the defence.

**Mitigation measures required for Section 2a and 2b**

4.5.5 Potential coastal process impacts should be mitigated through the adoption of good construction practices. As much work as possible will be non-tidal (i.e. undertaken above MHWS or during periods that allow for dry working).

4.5.6 All tidal work schedules should be assessed two weeks in advance of the works. Works should also cease during storm events. These practices will again assist in reducing the amount of material available for entrainment within the water column.

**Mitigation measures required for Section 3a and 3b**

4.5.7 Potential coastal process impacts should be mitigated through the adoption of good construction practices. Most work will be non-tidal (i.e. undertaken above MHWS or during periods that allow for dry working), with the exception of excavation for the rock armour toe. All intertidal works should cease three hours prior to the anticipated high tide time. In addition, the revetment will be constructed in short sections that can be completed during a single tidal period. These practices will eliminate the potential for excavation operations introducing sediment into the water column.

4.5.8 Excavated sediments will be re-used to cover adjacent areas following completion of the preceding section. No material is to be stored on the foreshore, to reduce the risk of scour to adjacent intertidal habitat.

4.5.9 All tidal work schedules should be assessed two weeks in advance of the works. Works should also cease during storm events. These practices will again assist in reducing the amount of material available for entrainment within the water column.

4.5.10 The excavated mud should be deposited in small amounts, section-by-section as the defence is constructed, to avoid excessive amounts of sediment mobilisation. Coir erosion matting is to be used to cover deposited sediment, to reduce sediment mobilisation during construction and operation. This will promote the consolidation of the deposited sediment and the widespread and strategic use of brushwood between MHWN and HAT will encourage the natural, gradual deposition of fine sediment over time. These measures will further reduce the risk of sediment mobilisation whilst promoting the development of functional intertidal habitat above MHWN.

4.5.11 It is recommended that the mudflat levels adjacent to the sheet pile at section 3b are monitored via UAV on a yearly basis, at the same time each year, to avoid seasonal variations, over a period of five years. The surveys should focus on changes in elevation and extent, and if any decreasing trends are noted, the use of timber fascines and brushwood packing should be considered throughout the intertidal zone. Although current reflection is unlikely to be significantly increased by the revetment design, it is also recommended that mudflat levels on the opposite bank slightly downstream of section 3a are monitored in a similar way, to ensure that any potential impacts from current reflection are addressed at the earliest opportunity.

4.5.12 It is recommended that the performance of the grey-green aspect of the defence is monitored: where sediment is to be deposited on the top half of the Dycel Block scour protection. Levels and vegetation colonisation should be monitored on a yearly basis via UAV, at the same time of year during summer (in order to best capture potential saltmarsh vegetation). This should be conducted over a period of five years, to establish any erosional/depositional trends and potential habitat establishment.

### Mitigation measures required for Section 4

4.5.13 Potential coastal process impacts should be mitigated through the adoption of good construction practices. Most work will be non-tidal (i.e. undertaken above MHWS or during periods that allow for dry working), with the exception of excavation for the rock armour toe. All intertidal works should cease three hours prior to the anticipated high tide time. In addition, the revetment will need to be constructed in short sections that can be completed during a single tidal period. These practices will eliminate the potential for excavation operations introducing sediment into the water column.

4.5.14 Excavated sediments will be re-used to cover adjacent areas following completion of the preceding section. No material is to be stored on the foreshore, to reduce the risk of scour to adjacent intertidal habitat.

4.5.15 All tidal work schedules should be assessed two weeks in advance of the works. Works should also cease during storm events. These practices will again assist in reducing the amount of material available for entrainment within the water column.

4.5.16 The excavated mud should be deposited in small amounts, section-by-section as the defence is constructed, to avoid excessive amounts of sediment mobilisation. Coir erosion matting is to be used to cover deposited sediment, to reduce sediment mobilisation during construction and operation. This will promote the consolidation of the deposited sediment and the widespread and strategic use of brushwood between MHWN and HAT will encourage the natural, gradual deposition of fine sediment over time. These measures will further reduce the risk of sediment mobilisation whilst promoting the development of functional intertidal habitat above MHWN.

4.5.17 Although current reflection is unlikely to be significantly increased by the revetment design, it is also recommended that mudflat levels on the opposite bank slightly downstream of section 4 are monitored on a yearly basis via UAV, to ensure that any potential impacts from current reflection are addressed at the earliest opportunity.

4.5.18 It is recommended that the performance of the grey-green aspect of the defence is monitored: where sediment is to be deposited on the top half of the Dycel Block scour protection. Levels and vegetation colonisation should be monitored on a yearly basis via UAV, at the same time of year during summer (in order to best capture potential saltmarsh vegetation). This should be conducted over a period of five years, to establish any erosional/depositional trends and potential habitat establishment.

### Mitigation measures required for Section 5

4.5.19 Potential coastal process impacts should be mitigated through the adoption of good construction practices. All work will be non-tidal (i.e. undertaken above MHWS or during periods that allow for dry working).

4.5.20 All tidal work schedules should be assessed two weeks in advance of the works. Works should also cease during storm events. These practices will again assist in reducing the amount of material available for entrainment within the water column.

## 4.6 Residual Effects

### Hydromorphology

***Section 1***

4.6.1 The proposals are considered to have No Significant Residual Effect on coastal processes and geomorphology. Any sediment mobilisation during construction and operation is considered to be small-scale and localised, whilst the mitigation measures detailed above will reduce this potential risk further. There is predicted to be No Significant Effect on the sediment budget and on the adjacent intertidal habitat, provided the scheme is monitored at regular intervals.

***Sections 2a and 2b***

4.6.2 The proposals are considered to have No Significant Residual Effect on coastal processes and geomorphology, mainly due to the embankment being constructed above HAT. The mitigation measures described will further reduce the risk of sediment mobilisation during construction.

***Sections 3a and 3b***

4.6.3 The proposals are considered to have No Significant Residual Effect on coastal processes and geomorphology. Measures incorporated into the design and construction process will reduce the impacts on hydrodynamics and sediment mobilisation. Replacing the cliffed intertidal bank with a gentle gradient from below MLW to HAT and the incorporation of bioengineering in the top section of the design provides good potential for improved sediment deposition rates and a smooth transition from mudflat into saltmarsh above MHWN. Additionally, the mudflat at section 3b should be monitored at regular intervals, to inform future management of the estuary edge.

***Section 4***

4.6.4 The proposals are considered to have No Significant Residual Effect on coastal processes and geomorphology. Measures incorporated into the design and construction process will reduce the impacts on hydrodynamics and sediment mobilisation. Replacing the cliffed intertidal bank with a gentle gradient from below MLW to HAT and the incorporation of bioengineering in the top half of the design provides good potential for improved sediment deposition rates and a smooth transition from mudflat into saltmarsh above MHWN.

***Section 5***

4.6.5 The proposals are considered to have No Significant Residual Effect on coastal processes and geomorphology, mainly due to the sheet pile wall being constructed above HAT. The mitigation measures described will further reduce the risk of sediment mobilisation during construction.

# 5 Biodiversity and Nature Conservation

## 5.1 Introduction

5.1.1 Schedule 4 of the EIA Regulations, sets out the requirements for information to be included in the ES (inter alia) 'a description of the factors specified in regulation 4(2) likely to be significantly affected by the development: …flora and fauna…'.

5.1.2 The location of the proposed development in the Severn Estuary means that there is a range of flora and fauna that could potentially be impacted. Ecological systems are present, elements of which form part of both designated and undesignated ecological species and habitats. This chapter will therefore assess the impact of the development proposals on the biodiversity and nature conservation value of the ecological systems operating in the Severn Estuary and Rhymney River.

5.1.3 Wildlife sites formally designated under the Conservation of Habitats and Species Regulations 2017 (as amended by Conservation of Habitats and Species Amendment (EU Exit) Regulations 2019) (the 'Habitats Regulations') are present within the Severn Estuary, meaning that as well as EIA, a Habitats Regulations Assessment (HRA) is also required. Regulation 26(1) of the aforementioned EIA Regulations requires that: 'where in relation to EIA development there is, in addition to the requirement for an environmental impact assessment to be carried out, also a requirement to carry out a Habitats Regulations Assessment, the relevant planning authority (or the Welsh Ministers, as the case may be) must where appropriate ensure that the Habitats Regulations Assessment and the environmental impact assessment are co-ordinated'.

5.1.4 This chapter therefore considers two aspects of biodiversity and nature conservation: (1) the impact of the development proposals on the conservation objectives of wildlife sites designated under the Habitat Regulations; and (2) the wider impact of the proposals on ecological systems that form part of other designated and undesignated species and habitats.

5.1.5 The designated and undesignated species and habitats that fall outside of the Habitats Regulations are assessed within this chapter following the wider EIA methodology, and with due regard to the Rochdale Envelope Approach, where relevant. Impacts on wildlife sites, designated under the Habitats Regulations, are also assessed herein with regard to the Precautionary Principle. However, it must be noted that any pre-mitigation Likely Significant Effects on the conservation objectives of these sites are to be coordinated with the HRA Assessment. This overall approach is considered to be consistent with relevant case law relating to both EIA (i.e. R. v Rochdale MBC ex parte Milne [2000]) and HRA Screening (i.e. People Over Wind & Sweetman v. Coillte Teoranta [2018]).

## 5.2 Methodology

5.2.1 The ecological baseline conditions have been determined from a Preliminary Ecological Appraisal (PEA) comprising a desk-based assessment and an Extended Phase 1 Habitat Survey, supplemented by specialist surveys.

### Desk-based Assessment

5.2.2 As part of the desk-based assessment, information was sought for all relevant statutory sites within a 5km radius and non-statutory sites within a 1km radius of the development site's boundaries, however this was expended where necessary to include relevant hydrologically linked sites. Data was also collected on records of species within

2km with legal protection, or of nature conservation importance within the research area. Information was requested from Cardiff County Council, including records of non-statutory designated nature conservation sites (i.e. Sites of Importance to Nature Conservation (SINCs)), protected species, and species of conservation concern. A request was also made to the British Trust for Ornithology (BTO) for data from the Wetland Bird Survey (WeBS), a partnership survey between the BTO, the Royal Society for the Protection of Birds (RSPB), and the Joint Nature Conservation Committee (JNCC) (on behalf of the statutory nature conservation bodies), in association with the Wildfowl and Wetlands Trust. A request was made for data from the compartments that cover the areas of the proposed scheme, namely Rhymney Estuary and Great Wharf. Additional data was also collected from the following sources:

- MAGIC website;
- The Lle Geo-Portal

For species such as fish relevant species data was considered for the entire Severn Estuary and tributaries

#### Extended Phase 1 Habitat Survey

5.2.3 An Extended Phase 1 Habitat Survey was carried out by an experienced Ecologist on the 23rd November 2016 and was conducted following the JNCC survey method (JNCC, 2010). The methodology of the Phase 1 Habitat Survey involves classifying and mapping parcels of land using specified habitat types. An Extended Phase 1 Habitat Survey involves determining the suitability of these habitats for supporting rare or legally protected species. The survey was extended to include consideration of notable/protected habitats and species, such as Badger, Otter, Dormouse, reptiles, Great Crested Newt and invertebrates (CIEEM, 2013). A secondary survey was undertaken on the 21st March 2019, to update the original results obtained in 2016. The extent of the Phase 1 survey is shown in the Habitat Map included in Appendix C.

#### Botanical Survey

5.2.4 Furthermore, a detailed botanical survey was carried out on the 14th October 2019 by JBA Ecologists. This involved a walkover of all accessible areas of saltmarsh on the site. Stands of vegetation were identified by eye on site and mapped onto aerial imagery. Species were recorded along with their abundance. The vegetation stands could be relatively easily assigned to describe vegetation, so no quadrats were necessary. Vegetation was initially assigned to a community or sub-community of the National Vegetation Classification (NVC) (Rodwell 1992, 2000). These communities were then assigned to a corresponding Annex I habitat using the interpretation manual (European Commission 2013).

### 5.3 Ecology Baseline

#### Statutory designated sites

5.3.1 The Severn Estuary European Marine Site (EMS) is designated as a SPA, SAC, and Ramsar site (see Appendix C), with a further six statutory designated sites located within 5km of the proposed development (Table 5-1).

**Table 5-1: Summary of nature conservation designations and associated interest features**

| Designation | Interest features |
|---|---|
| Severn Estuary SPA | Qualifying features:<br>• European important populations of certain species over winter (Bewick's Swan) |

| Designation | Interest features |
|---|---|
| | • Internationally important populations of regularly occurring migratory bird species overwinter (Gadwall, White-fronted Goose, Dunlin, Shelduck, Redshank)<br>• Internationally important assemblage of waterfowl over winter. |
| Severn Estuary SAC | Features of interest:<br>• Estuaries<br>• Sandbanks which are slightly covered by sea water all the time<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Atlantic salt meadow (*Glauco-Puccinellietalia maritimae*)<br>• Reefs<br>• River lamprey *Lampetra fluviatilis*<br>• Sea lamprey *Petromyzon marinus*<br>• Twaite shad *Alosa fallax* |
| Severn Estuary Ramsar Site | Features of interest:<br>• Intertidal habitats including estuaries, sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide and Atlantic salt meadows.<br>• Unusual estuarine communities, with reduced diversity and high productivity<br>• Run for migratory fish species including salmon, sea trout, sea lamprey, river lamprey, allis shad, twaite shad and eel.<br>• Internationally important assemblage of waterfowl in winter<br>• Species/populations occurring at levels of international important in winter (Bewick's Swan, White-fronted Goose, Shelduck, Gadwall, Dunlin and Redshank).<br>• Assemblage of fish species, with important migration routes, and feeding, spawning and nursery grounds. |
| Severn Estuary SSSI | The estuarine fauna includes: internationally important populations of waterfowl; invertebrate populations of considerable interest; and large populations of migratory fish, including the nationally rare and endangered Allis Shad *Alosa alosa*. The SSSI forms the major part of a larger area of estuarine habitat, which includes the Upper Severn Estuary, the Taf/Ely Estuary and Bridgwater Bay.<br><br>The estuary fringes have large areas of saltmarsh. These are generally grazed by sheep and/or cattle, a significant factor determining the plant communities. A range of saltmarsh types is present, with both gradual and stepped transitions between bare mudflat and upper marsh. Glassworts *Salicornia* spp and Annual Sea-blite *Suaeda maritima* colonise bare mud on the lower saltmarshes, and disturbed areas at higher levels. Common Cord-grass *Spartina anglica* is abundant on the seaward fringes of marshes, where it occurs as dense monocultures, or with other species, such as Sea Aster *Tripolium pannonicum*, Greater Sea-spurrey *Spergularia media* and Common Saltmarsh-grass *Puccinellia maritima*. The middle marsh is mainly dominated by Common Saltmarsh-grass, and frequent associates include Sea-milkwort *Glaux maritima*, English Scurvygrass *Cochlearia anglica* and Sea Arrowgrass *triglochin maritima*, together with two nationally scarce plants Bulbous Foxtail *Alopecurus bulbosus* and Slender Hare's-ear *Bupleurum tenuissimum*. There are a few localities for an uncommon middle marsh community, which is sea lavender.<br><br>The fluctuating salinity and highly mobile sediments with consequent high turbidity limits the benthic invertebrates to relatively few species. Those which are tolerant of such conditions occur in very high densities on the more stable mudflats. The most prominent species are ragworm *Nereis* spp, Lugworm *Arenicola marina*, Baltic Tellin *Mocoma balthica* and the spire shell *Hydrobia ulvae*. A greater variety of invertebrates tend to occur on the intertidal rock platforms, a more stable habitat with rock pools and a relatively high cover of seaweeds. |

| Designation | Interest features |
|---|---|
| | Seven species of migratory fish move through the Estuary between the sea and rivers. There are particularly large numbers of Atlantic Salmon *Salmo salar* and Common Eel *Anguilla anguilla*. The other species are Allis Shad, the nationally rare Twaite Shad *Alosa fallax*, the Sea Trout *Salmo trutta*, Sea Lamprey *Petromyzon marinus* and the Lampern or River Lamprey *Lampetra fluviatilis*.<br><br>The SSSI is of international importance for wintering and passage wading birds, with total winter populations averaging about 44,000 birds. Numbers can be considerably higher during severe winters when owing to its mild climate, the Severn supports wader populations that move in from the colder coasts of Britain. The SSSI holds most of the estuary's internationally important Curlew *Numenius arquata* and Redshank *Tringa totanus* populations, and most of its nationally important Ringed Plover *Charadrius hiaticula* and Grey Plover *Pluvialis squatarola* populations. Other waders which occur in significant numbers within the SSSI are Common Snipe *Gallinago gallinago*, Knot *Calidris canutus*, Whimbrel *Numenius phaeopus* and Turnstone *Arenaria interpres*. The SSSI is internationally important for Dunlin *Calidris alpina* and supports about 7.5% of the British wintering population of this species. The estuary as a whole supports about 10.5% of the British wintering population and is the single most important wintering ground of Dunlin in Britain. |
| Gwent Levels SSSI | Features of interest:<br>• Reen and ditch habitat<br>• Insects and other invertebrates<br>• Shrill carder bee |
| Rumney and Peterstone SSSI | Features of interest:<br>• Ditch habitat drainage system<br>• Rare plants<br>• Invertebrates |
| St Brides SSSI | Features of interest:<br>• Drainage ditches and reen habitat<br>• Rare or notable invertebrate species<br>• Plant species |
| Rumney Quarry SSSI | Features of interest:<br>• Exposed 425-430 million year old rocks |
| Rhymney River Section SSSI | Features of interest:<br>• Geological exposures of rock |
| Penylan Quarry SSSI | Features of interest:<br>• Geological exposures of Pen-y-lan mudstones and marine fossils |

### Non-statutory nature conservation sites

5.3.2 In addition to the statutory designated sites, there are five non-statutory designated sites located within 1km of the proposed development. These are referred to as Sites of Importance for Nature Conservation (SINC) and are shown in Table 5-2, and Appendix D.

**Table 5-2: Non-statutory Sites of Nature Conservation Importance (SNCI) falling either wholly or partially within the 2km search area**

| Site name | Approximate distance from central site NGR | Nature conservation interest |
|---|---|---|
| Lamby North SINC | 600m North | An area of inland saltmarsh located on the eastern bank of the Rhymney River. |

| Site name | Approximate distance from central site NGR | Nature conservation interest |
|---|---|---|
| Lamby Saltmarsh SINC | Adjacent | An area of salt marsh located on the eastern banks Rhymney River and fringing the Severn Estuary. |
| Lamby Way SINC | 800m to the north-east | An area of damp semi-improved neutral grassland which supports Grass Snake *Natrix natrix* and Cetti's Warbler *Cettia cetti*, located immediately to the south of Parc Tredelerch. |
| Rhymney Grassland Easy SINC | 1km north | An area of neutral semi-improved grassland with some calcareous semi-improved grassland located on the western bank of the Rhymney River. |
| The Rhymney River SINC | | The Rhymney River is designated for its importance for migratory fish, Otters, wildfowl and bankside vegetation it also acts as a wildlife corridor for bats, Dormice and Grass Snakes. Eel and trout have also been recorded in the River. |

### Habitats

#### *Running water*

5.3.3 The proposed development is located within the Severn Estuary. The estuary is fully tidal and consists of highly mobile sediments and extensive subtidal sandbanks and mudflats in the area of the works. The study area also includes the Rhymney River from its confluence with the Severn Estuary to approximately 800m upstream. The river in this section is also fully tidal and subject to the same tidal range as the Severn Estuary. It is relatively slow flowing, and has a number of large meanders.

#### *Intertidal mudflats*

5.3.4 The Severn Estuary foreshore consists of extensive intertidal mudflats throughout the extent of the scheme, extending up to 2km into the Severn Estuary channel, which are exposed at low tide. Intertidal mudflats are also present along the Rhymney River, with large areas exposed along both banks of the channel, and in particular, at the meanders in the river, at low tide. This habitat qualifies as the Annex I habitat 1140 Mudflats and sandflats not covered by seawater at low tide

5.3.5 Mudflats are considered highly productive areas, providing feeding and resting areas for internationally important populations of migrant and wintering waterfowl, and are also important nursery areas for fish.

#### *Intertidal boulders/cobbles*

5.3.6 A small amount of rocky habitat is present within the foreshore area, primarily to the west of the Rhymney River. The communities present are consistent with those found on sheltered upper eulittoral bedrock with Spiral Wrack *Fucus spiralis* most common.

5.3.7 To the east of the Rhymney River, fucoid species have settled on the toe of the existing remnant blockstone flood defences, with Spiral Wrack again abundant.

#### *Coarse sand above the high tide mark*

5.3.8 Immediately to the east of the Rhymney River, small pockets of barren littoral sand are present. Sand casts, most likely from Ragworm, were locally common within these areas during the habitat surveys in 2016 and 2019.

### *Shingle/gravel above high-tide mark*

5.3.9 Shingle and gravel form a narrow band along much of the coastline foreshore, primarily to the west of the Rhymney River. For the most part, this was formed from eroded Frag Tip material and other disposed materials. This area was largely devoid of plant life and the highly mobile nature of the coarse material means that this area is unlikely to support large numbers of macroinvertebrates.

### *Boulders/rocks above high-tide mark*

5.3.10 The existing, remnant flood defences located along the Estuary consist of a mixture of formal blockstone revetment and reused building materials. In some areas, a community of yellow and grey lichens have colonised within the splash zone. To the west of the Rhymney River, this habitat consists of exposed tip waste and the remnants of historic flood defences; the majority of this material is devoid of plant or animal life with only a very sparse number of lichens recorded.

### *Saltmarsh*

5.3.11 Atlantic salt meadow was recorded on the banks of the Rhymney River and fringing the existing flood defence along the Severn Estuary to the east of the river. The largest sections of saltmarsh are bordering the Rhymney River, with the largest of these located on the lowest two meanders of the river. These sections were grazed and consisted predominantly of species indicative of mid to upper saltmarsh communities. Several drainage channels provided opportunities for saltmarsh herb species, with Sea Beet *Beta vulgaris* subsp. *maritima* most common. Within the saltmarsh, saline reedbeds were also present on the eastern side of the Rhymney River.

5.3.12 The vegetation on site represents typical saltmarsh habitat occurring in western British saltmarshes. A total of 8.2ha of the vegetation qualifies as the Annex I habitat 'H1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', a designated feature of the Severn Estuary SAC, in which at least part of the study area is located. These communities are also notifiable features of the Severn Estuary SSSI, and Habitats of Principal Importance under Section 7 of the Environment (Wales) Act 2016 (formerly UK BAP priority habitats).

5.3.13 To the east of the Rhymney River, saltmarsh fringes the existing remnant Severn Estuary flood defence. The community present is again indicative of mid to upper saltmarsh communities, with cord-grasses *Spartina* sp. present closer to the seaward side and on sections of soil that have fallen onto the foreshore. Scattered fragments of saltmarsh vegetation are also present beyond the flood defence where the ground is high enough not to be completely inundated by the tide.

### *Dense scrub*

5.3.14 Dense scrub is present along the roadsides of Rover Way and Lamby Way, with locally dominant areas of Japanese Knotweed *Reynoutria japonica*. A ground covering of Ivy *Hedera helix* is present where the scrub thins out.

5.3.15 Dense scrub separates the industrial areas to the west of the Rhymney River from the coastline. To the west of the Rhymney River, dense scrub in the form of Hawthorn *Crataegus monogyna*, Willow *Salix* sp., Bramble *Rubus* sp., scattered Gorse *Ulex* sp. and large areas of Buddleia *Buddleja davidii* is present on the steep sloping ground behind the foreshore area. This area forms a mosaic of habitats, with tall ruderal and grassland habitats also present.

### *Semi-natural broadleaved woodland*

5.3.16 Broadleaved trees line both Rover Way and Lamby Way which are predominantly Poplar *Populus* sp. and Sycamore *Acer pseudoplatanus*. To the east of the Rhymney River, areas of broadleaved woodland have been planted at the base of the Lamby Way Landfill; these areas were surveyed from approximately 500m away on the opposite side of the river, with Silver Birch *Betula pendula* and Oak *Quercus robur* identified as being dominant.

### *Coastal grassland*

5.3.17 Coastal grassland is present in transitional areas behind areas of saltmarsh. Grassland indicative of the coastal environment is also present within the areas of scrub and tall ruderal habitats along Lamby Way and Rover Way.

### *Tall ruderal*

5.3.18 Lining the roadsides of Lamby Way and Rover Way, tall ruderal species have colonised less disturbed areas and pavements and include common species such as Willowherbs *Epilobium* sp., Creeping Thistle *Cirsium arvense*, Common Nettle *Urtica dioica* and False Oat-grass *Arrhenatherum elatius*. This forms a mosaic of habitats with areas of dense scrub and grassland.

## Species

### *Invertebrates*

5.3.19 The intertidal and subtidal mudflats described provide suitable habitat for a range of macroinvertebrate species. The range of sediment sizes present mean that it is likely that a diversity of macroinvertebrate communities has been able to develop, which in turn provide an important food source for bird and fish species associated with the Severn Estuary.

5.3.20 Honeycomb Worm *Sabellaria alveolata* reefs have been recorded approximately 2km into the channel[23]. This polychaete worm constructs tubes from sand or shell fragments in tightly packed masses, which form a honeycomb appearance and provide habitats for a variety of other invertebrates. The reefs recorded in this area are subtidal and none were recorded in the intertidal zone during the survey.

5.3.21 The wet grazing marsh of the adjacent Gwent Levels is a stronghold for the rare Shrill Carder Bee *Bombus sylvarum*.

5.3.22 Saltmarsh within the project area can also provide habitat for several invertebrate species, with typical assemblages consisting of a range of marine and freshwater benthic species as well as terrestrial species. Saltmarsh provides a potential corridor to suitable habitats in the wider area and has been identified as an important habitat for several rare bee species including the Shrill Carder Bee and Large Carder Bee *Bombus muscorum*. Further terrestrial habitats within the scheme area provide limited habitat terrestrial invertebrate species.

[23] MODnet - European Marine Observation Data Network (EMODnet) Seabed Habitats project (http://www.emodnetseabedhabitats.eu/)

### *Fish*

5.3.23 The Severn Estuary and Bristol Channel fish community comprises over 100 recorded species of fish (Potts and Swaby, 1993; Henderson and Bird, 2010), including a number of internationally and nationally designated estuarine and migratory fish species.

5.3.24 The Severn Estuary EMS is designated for a range of migratory fish species; a number of these are for migratory species that are likely to spawn further up river, including rare Shad species. Migratory fish such as Trout *Salmo trutta* and Eel *Anguilla anguilla* have also been recorded within the Rhymney River catchment, and it is likely that these species migrate through the works area to the Severn Estuary. The scheme will not impact upon habitats suitable for spawning.

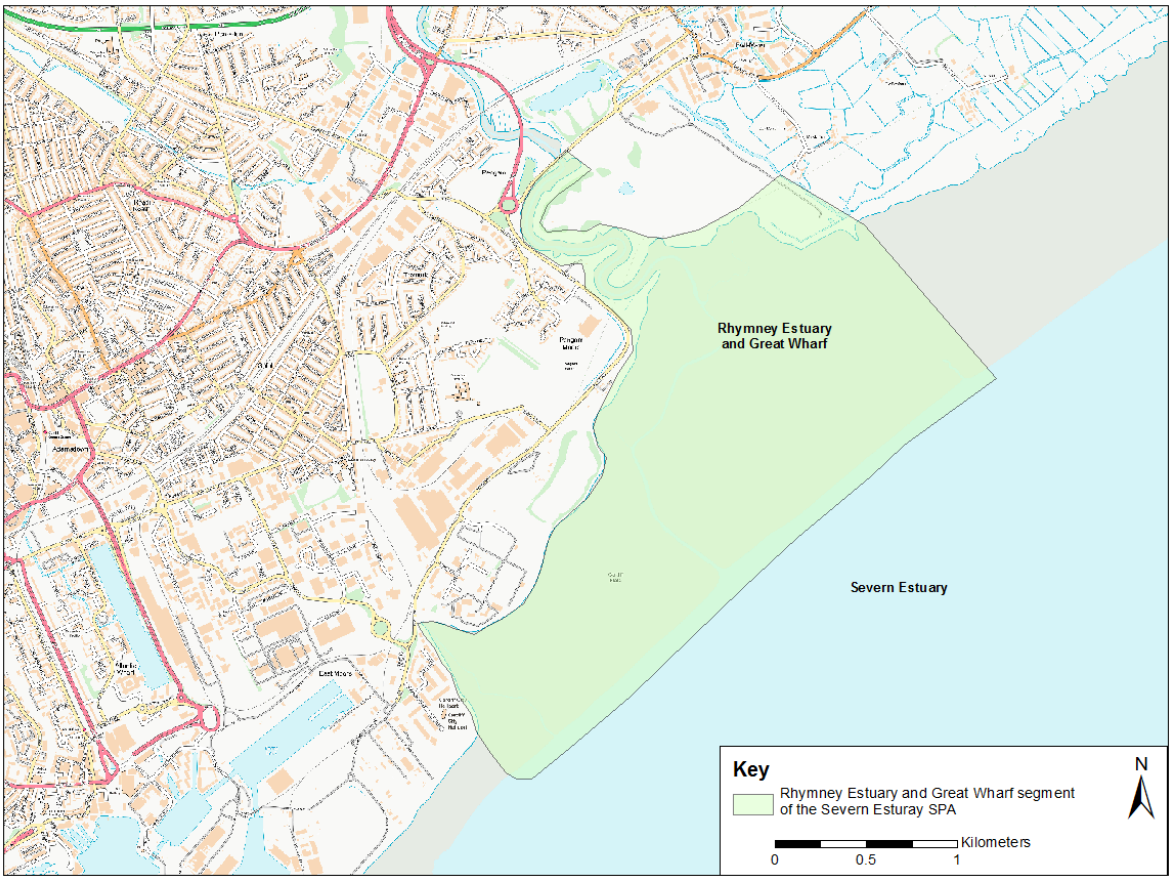
5.3.25 The diadromous species which migrate through the Severn Estuary are all protected under either national or international conservation designations. All seven diadromous fish species Atlantic Salmon, Sea Trout, Sea Lamprey, River Lamprey, Allis Shad, Twaite Shad and European Eel) are qualifying features of the River Severn Ramsar under Ramsar Criterions 4 and 8.

5.3.26 Ten other species, Cod *Gadus morhua*, Herring *Clupea hargenus*, Plaice *Pleuronectes platessa*, Sole *Solea solea*, Whiting *Merlangius merlangus* Blue Whiting *Micromesistius poutassou*, Hake *Merluccius merluccius*, Horse Mackerel *Trachurus trachurus*, Ling *Molva molva* and Saithe *Pollachius virens,* recorded in the Severn Estuary are recognised under the UK Post-2010 Biodiversity Framework which includes a number of strategic goals and supporting targets (JNCC and Defra 2012). Given the scheme will not impact upon nursery grounds or subtidal habitats it is not considered that the scheme will have an impact upon these species.

### *Birds*

5.3.27 The intertidal mudflats and areas of saltmarsh provide foraging and roosting habitat for a range of wintering wildfowl and wading bird species, many of which are qualifying features of the Severn Estuary EMS.

5.3.28 In order to inform this study, a request was made to the British Trust for Ornithology (BTO) for data from the Wetland Bird Survey (WeBS), a partnership survey between the BTO, the Royal Society for the Protection of Birds (RSPB) and the JNCC (the last on behalf of the statutory nature conservation bodies: Natural England, Natural Resources Wales, Scottish Natural Heritage and the Department of the Environment Northern Ireland) in association with the Wildfowl and Wetlands Trust. A request was made for data for the compartment that cover the areas of the proposed scheme, namely Rhymney Estuary and Great Wharf, this area is shown in Figure 5-1.




5.3.29 BTO WeBS data revealed a total of 34 wading, wildfowl and gull species have been recorded utilising the habitats within the relevant compartment (the compartment is significantly larger than the works area). This data shows that the mudflats within and adjacent to the scheme area support significant populations of wintering birds associated with Severn Estuary protected site. This data demonstrates that the Rhymney Estuary and Great Wharf section of the Severn Estuary supports substantial percentages of wetland birds, including 29.21% of all Redshank *Tringa totanus* and 24.46% of Pintail *Anas acuta* populations in the Severn Estuary. Important numbers of Shoveler *Anas clypeata* are also found and comprise 11.8% of the total Shoveler population using the Severn Estuary SPA. Data obtained from NRW show that the saltmarsh located on the northern bank of the Rhymney has been identified as an important high tide roost for Redshank. The other wildfowl species detailed above are associated with the intertidal mudflats and open water habitats of the Severn and large numbers have not been recorded within the Rhymney itself.

5.3.30 Given the large amount of data available it was agreed in consultation with NRW that further bird surveys were not required. However, whilst no formal surveys have been carried out, a JBA Consulting ecologist was present on site at least once a month in a variety of tidal states between October 2020 and April 2021 and recorded the use of the Rhymney by wintering and migratory bird species. During this time the intertidal mudflats within the Rhymney were not well used by wading species with a peak count of eight Common Ringed Plover *Charadrius hiaticula* recorded beneath the overhanging terrestrial vegetation on the final meander. No birds were recorded within the direct footprint of the proposed works and the steep nature of the banks where works are proposed mean that they do not have high potential for foraging bird species.

5.3.31 A large number of records were provided for terrestrial bird species, including Cetti's Warbler *Cettia cetti* and Kingfisher *Alcedo atthis*, with Cetti's Warbler having been recorded in the reedbeds adjacent to the scheme area. The saltmarsh and surrounding scrub habitat provides nesting and foraging opportunities for a range of bird species, whilst the saltmarsh provides potential for ground nesting species such as Lapwing *Vanellus vanellus*. A survey carried out in May and June 2021 did not find any ground nesting species within or adjacent to the proposed scheme.

***Amphibians***

5.3.32 No records for Great Crested Newt *Triturus cristatus* were provided within 2km of the proposed scheme. However, suitable terrestrial habitat for Great Crested Newt was recorded in the form of a scrub-grassland mosaic located along Rover Way and Lamby Way. Two ponds were identified at the eastern extent of the study area; these were considered to hold potential for Great Crested Newt, with suitable terrestrial habitat located to the north of this area. Parc Tredelerch also provides suitable terrestrial habitats. The latest scheme design will no longer impact these areas and therefore a potential impact upon Great Crested Newt is not expected and no further surveys of these ponds were undertaken.

5.3.33 Records within 2km of the scheme area were provided for Common Frog *Rana temporaria*, Common Toad *Bufo bufo*, and Palmate Newt *Lissotriton helveticus*. The closest record for each of these was located approximately 200m to the north-west of the scheme area. The grassland-scrub mosaics provide habitat for these species.

5.3.34 Natterjack Toads *Epidalea calamita* breed in saline pools, where the saline conditions have flushed most predators away. Whilst pools within the saltmarsh area do provide some potential for this species, the surrounding habitat offers low potential for other stages of their lifecycle and it is considered that the presence of Natterjack Toads is unlikely. No records for Natterjack Toad within 2km of the proposed scheme were provided.

***Reptiles***

5.3.35 There are records for Grass Snake *Natrix natrix* and Slow Worm *Anguis fragilis* within 2km of the scheme area, with records for Slow Worm located between the Rhymney River and the Lamby Way Landfill. Whilst no records were provided in the data search, the Cardiff City Council Ecologist has highlighted that it is likely that Common Lizard is also present.

5.3.36 Areas of scrub-grassland mosaic bounding the river have the potential support a number of species of reptiles. The habitats within Parc Tredelerch also have the potential to support a range of reptile species. Species such as Grass Snake are also known to utilise saltmarsh habitats. No reptile surveys were undertaken, however, given that impacts to these habitats will be limited to the construction phase it is considered suitable that their presence is assumed.

***Badger***

5.3.37 There are no records of Badger *Meles meles* within 2km of the proposed works. No signs of Badger were recorded during the site surveys; however, habitat suitable for Badger to excavate setts was recorded within the dense scrub located along Lamby Way and Rover Way, as well as the habitats within Parc Tredelerch. These areas also provide foraging potential for Badger. There is also the potential for setts to be excavated within the steep scrub areas located to the west of the Rhymney.

### *Otter*

5.3.38 Otter *Lutra lutra* have been recorded within 2km of the scheme area and are known to be present within the Rhymney River catchment. Therefore, it is likely that Otter will pass through the works area. Due to the exposed nature of the mudflats, it is unlikely that Otter will utilise the banks of the river for resting or holt sites. However, the dense scrub that lines the river, as well as areas of reedbed within the saltmarsh, have the potential to provide resting and holt sites for Otter. Habitats located within Parc Tredelerch have the potential to provide holt sites in some of the areas of denser vegetation and reedbeds. No evidence of Otter was recorded during the sueveys.

### *Water Vole*

5.3.39 A large number of records within 2km of the scheme extent were provided for Water Vole *Arvicola amphibius*, with the closest records located within drainage ditches 200m to the east of the scheme extent. A drainage channel to the east of the Lamby Way Landfill was considered suitable for Water Vole although no evidence was recorded during the 2016 or 2019 surveys. However, the drainage ditches or surrounding habitats will not be impacted upon by the proposed scheme and it is considered appropriate that indirect impacts such as pollution events are managed throughout the construction with appropriate working practices.

### *Bats*

5.3.40 No buildings suitable for roosting bats were identified within the scheme area. Broadleaved woodland located adjacent to the scheme area was predominantly of a young age and is therefore unlikely to provide potential roosting features, such as cracks, knot holes or lifted bark. However, given the large size of the study area, no large-scale survey of trees for bat roost potential were carried out.

5.3.41 Trees likely to be impacted by the scheme are limited to an area of planted sub-mature Birch and Willow adjacent to the roundabout at Lamby Way and Rover Way. These trees were assessed for bat roost potential and were determined to have negligible potential for roosting bats at the time of survey.

5.3.42 The scheme area is likely to provide foraging habitat for bats, with the potential for a large number of invertebrate species associated with the saltmarsh, dense scrub, and broadleaved woodland habitats. It is also likely that the river corridors provide commuting opportunities.

### *Dormice*

5.3.43 Dormice have been identified on the Gwent Levels, however, habitats within the scheme area provide limited potential for Dormice. Suitable habitat within the scheme area is limited to isolated patches of Bramble located along Lamby Way which provide some potential for hibernating Dormice. However, it is considered that this habitat is isolated and not connected to areas suitable for foraging Dormice. It is therefore considered that Dormice will not be present within the scheme areas.

### *Marine mammals*

5.3.44 A number of marine mammals are known to commute and forage within the Severn Estuary, and there are records for Common Porpoise *Phocoena phocoena* and Grey Seal *Halichoerus grypus* within 2km of the scheme area.

### *Invasive non-native species*

5.3.45 Japanese Knotweed is abundant along the roadside verges of Lamby Way and Rover Way.

5.3.46 A number of marine INNS have been recorded within the Severn Estuary including Zebra Mussel *Dreissena polymorpha* and Killer Shrimp *Dikerogammarus villosus*, both of which have been recorded within Cardiff Bay.

## 5.4 Assessment Methodology and Significance Criteria

### Impact assessment

5.4.1 The assessment of ecological impacts was undertaken following best practice guidance provided by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018). This assessment identifies the potential effects of the proposed works on biodiversity (ecological receptors) within the site boundary and the wider zone of Influence. It determines the significance of the identified effects for the construction and operational phases.

5.4.2 The assessment of the significance of predicted impacts on ecological receptors is based on both the 'importance' of a feature and the nature and magnitude of the impact that the project will have on it. Impacts may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects due to noise, dust or disturbance).

5.4.3 The impact assessment process involves:

- Identifying and characterising impacts;
- Incorporating measures to avoid and mitigate (reduce) these impacts;
- Assessing the significance of any residual effects after mitigation;
- Identifying appropriate compensation measures to offset residual effects; and
- Identifying opportunities for ecological enhancement.

5.4.4 The assessment includes potential impacts (direct, indirect, secondary and cumulative) on each ecological receptor determined as important from all phases of the project and describes in detail the impacts that are likely to be significant, making reference to the following characteristics:

- Positive or negative
- Extent
- Magnitude
- Duration
- Timing
- Frequency
- Reversibility

### Value of ecological receptors

5.4.5 It is impractical to assess the impacts of the works on every ecological receptor (habitat, species) that may be affected. Instead, the assessment focuses on those features that are important, namely, ecological receptors that are valued in some way and could be affected by the proposed project. Other valued ecological receptors may occur on, or in the vicinity of, the proposed works area but do not need to be considered because there is no potential for them to be affected significantly.

5.4.6 Various characteristics were used to assess the importance of ecological receptors, for example naturalness, rarity, diversity and connectivity. The importance of an ecological feature was considered within a defined geographical context. For the purposes of this assessment the following frame of reference has been used:

- International and European
- National (UK/Wales)
- Regional/County (South Wales)

- Local (Cardiff City)
- Less-than-local (Rhymney corridor)

5.4.7 Consideration of impacts at all scales is important, and essential if objectives for no net loss of biodiversity and maintenance of healthy ecosystems are to be achieved. Ecological receptors have been valued using the scale set out in Table 5-8, with examples provided of criteria used when defining the level of importance.

**Table 5-3: Examples of the criteria used to define the importance of ecological features**

| Level of importance | Examples of criteria |
|---|---|
| International | • An internationally important site e.g. Special Protection Area (SPA), Special Area of Conservation (SAC), Ramsar (or a site considered worthy of such designation);<br>• A regularly occurring substantial population of an internationally important species (listed on Annex IV of the Habitats Directive). |
| National (UK/Wales) | • A nationally designated site e.g. SSSI, or a site considered worthy of such designation;<br>• A viable area of a habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole;<br>• A regularly occurring substantial population of a nationally important species, e.g. listed on Schedules 5 and 8 of the Wildlife and Countryside Act 1981 (as amended); |
| Regional/County (South Wales) | • Viable areas of S42 list or LBAP priority habitat, or smaller areas of such habitat which are essential to maintain the viability of a larger whole;<br>• A site designated as a non-statutory designated site e.g. Site of Importance for Nature Conservation (SINC);<br>• A regularly occurring substantial population of a nationally scarce species, including species listed on the S42 list or local BAP. |
| Local (Cardiff City) | • Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration;<br>• A good example of a common or widespread habitat in the local area;<br>• Species of national or local importance, but which are only present very infrequently or in very low numbers within site area. |
| Less-than-local (Rhymney corridor) | • Common, widespread and highly modified habitats of negligible conservation value.<br>• Common widespread species of no conservation concern of habitat on site highly unsuitable for more important species. |

5.4.8 The approach of this assessment is to consider the value of the site for the species under consideration, rather than the nature conservation importance of the species itself. While the importance of the species present is taken into account, in order to assess nature conservation importance, the number of individuals of that species using the site, and the nature and level of this use, is also taken into account, and an assessment is made of the value of the site to that species.

### Legally protected species

5.4.9 There is also a need to identify all legally protected species that could be affected by the proposed works in order that measures can be taken to ensure that contravention of the legislation is avoided. Therefore, it is inappropriate to assess the significance of impacts within the context of species' legal protection, as impacts on such species have to avoid contravention of the law, otherwise the scheme cannot go ahead.

5.4.10 Where a protected species is not considered to be an important ecological receptor, for example Badger, which is protected for animal welfare reasons rather than nature

conservation value, the measures that will be taken to ensure compliance with legislation are outlined within this chapter.

### Determining significant ecological effects

5.4.11 For the purposes of this assessment, a significant effect is an effect that either supports or undermines biodiversity conservation objectives for an important ecological receptor or for biodiversity in general (CIEEM, 2018). Significant effects encompass impacts on structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution).

**Table 5-4: Determining ecologically significant effects**

| Ecological Feature | Consideration |
|---|---|
| Designated sites | • Will the project undermine the site's conservation objectives?<br>• Will the project positively or negatively affect the conservation status of habitats or species for which the site is designated?<br>• Will the project have positive or negative effects on the condition of the site or its interest/qualifying features?<br>• Will the project remove or change any key characteristics?<br>• Will there be an effect on the nature, extent, structure and function of component habitats?<br>• Will there be an effect on the average population size and viability of component species?<br>• Will there be an impact on wider ecosystem functions and processes? |
| Habitats | • Will the project positively or negatively affect the conservation status of the habitat?<br>• Will it affect its extent, structure and function as well as its distribution and its typical species within a given geographical area? |
| Species | • Will the project positively or negatively affect the conservation status of the species?<br>• Will it affect its abundance and distribution within a given geographical area? |

### Residual impacts

5.4.12 Where impacts are identified, mitigation measures are proposed to avoid, reduce or minimise them. Embedded mitigation includes features that are an integral part of the proposed development and therefore are certain to be implemented. This mitigation is considered as part of the project design and therefore assessed at the initial impact stage. Mitigation suggested following impact assessment is additional to the mitigation already included in the project. Those impacts remaining after implementation of mitigation are the residual impacts.

5.4.13 An assessment of the residual impacts will be undertaken to determine the significance of their effects on ecological receptors.

## 5.5 Potential Impacts and Significant Effects

5.5.1 Based on the baseline data collected (Section 5.3), the development footprint and construction methodology (Chapter 2), and the ecology, population and legal status of the species and habitats present, an assessment of the potential impacts (positive and negative) and whether there are likely to be any significant effects of the project in the absence of mitigation was made (Table 5-11).

### Value (Sensitivity) of Resource and Receptors

5.5.2 An evaluation of each ecological resource/receptor in terms of its value, summarised from the baseline data collected, is presented in Table 5-10.

**Table 5-5: Summary of Ecological Features and Their Value**

| Ecological receptor | Evaluation rationale | Importance of feature or importance of site to feature |
|---|---|---|
| Severn Estuary SAC | Internationally important network of habitats including:<br>• Estuaries<br>• Sandbanks which slightly are covered by sea water all the time<br>• Mudflats and sandflats not covered by seawater at low tide<br>• Atlantic salt meadow (*Glauco-Puccinellietalia maritimae*)<br>• Reefs<br>Designated for internationally important populations of migratory species:<br>• River Lamprey *Lampetra fluviatilis*<br>• Sea Lamprey *Petromyzon marinus*<br>• Twaite Shad *Alosa fallax* | International |
| Severn Estuary SPA | European important populations of certain species over winter (Bewick's Swan).<br>Internationally important populations of regularly occurring migratory bird species overwinter (Gadwall, White-fronted Goose, Dunlin, Shelduck, Redshank).<br>Internationally important assemblage of waterfowl over winter. | International |
| Severn Estuary Ramsar | Intertidal habitats.<br>Unusual estuarine communities.<br>Run for migratory fish species.<br>Internationally important assemblage of waterfowl in winter.<br>Species/populations occurring at levels of international important in winter (Bewick's Swan, White-fronted Goose, Shelduck, Gadwall, Dunlin and Redshank).<br>Assemblage of fish species. | International |
| Severn Estuary SSSI | Further national protection for estuarine habitats, fish populations and over-wintering/migratory birds. | National |
| Gwent Levels: Rumney and Peterstone SSSI | National protection for ditch habitat drainage system a range of rare plants and invertebrates. | National |
| SINC sites | A network of SINC habitats includes the Rhymney River and adjacent saltmarsh. | Local |

| Ecological receptor | Evaluation rationale | Importance of feature or importance of site to feature |
|---|---|---|
| Annex I priority and designated feature habitats – Saltmarsh and Intertidal Mudflats | Saltmarsh and intertidal mud habitats along the Severn provide habitat for internationally important numbers of birds.<br>Intertidal mud habitats within and adjacent to the scheme have formed from large quantities of silt derived from rivers which has been deposited in estuaries. The sediment is stable and communities are typically dominated by polychaete worms and bivalve molluscs. | International |
| Annex I priority and designated feature habitats – Rhymney River saltmarsh and Intertidal Mudflats | Saltmarsh and mudflats along the Rhymney provide further habitat for wintering and migratory bird species associated with the Severn EMS. Intertidal mud habitats within the Rhymney have formed from large quantities of silt derived from upstream and the tidal influence of the larger Severn Estuary. The sediment is stable and communities are typically dominated by polychaete worms and bivalve molluscs. | National |
| Other habitats | A range of habitats line the river and estuary including dense scrub mostly in the form of dense stands of Bramble, tall ruderal vegetation and small stands of sub-mature broadleaved trees. | Local |
| Wintering and migratory birds including Severn Estuary EMS assemblage | Internationally important populations of regularly occurring wintering and migratory bird species.<br>Internationally important assemblage of waterfowl. | International |
| Nesting Birds | Suitable nesting habitat is present in the form of dense scrub and broadleaved trees. The grassland located within the Lamby Way tip site also provides habitat for ground nesting species such as Lapwing. | Local |
| Invertebrates (marine benthic) | The mudflats and saltmarsh in the Rhymney have the potential to support a range of benthic invertebrates. | Local |
| Invertebrates (terrestrial) | Terrestrial and saltmarsh habitats have the potential to support a range of invertebrate species. | Local |
| Fish | A number of fish of international importance migrate through the Severn and Rhymney Rivers. There are no suitable nursery grounds located within the work package areas. | International |
| Invasive non-native species | The INNS Japanese Knotweed listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) is present along much of the roadside at Lamby Way.<br>A number of Marine INNS have been recorded within the Severn Estuary, none were recorded during walkover surveys. | Local |
| Reptiles | Suitable terrestrial habitat for common reptile species is present along each bank. | Local |

| Ecological receptor | Evaluation rationale | Importance of feature or importance of site to feature |
|---|---|---|
| Water Vole | Ditches adjacent to the scheme area are suitable for Water Vole, but they will not be directly impacted by the scheme. | Local |
| Amphibians | The work areas are not considered suitable for Great Crested Newt, however, there is the potential for other common amphibian species to be present. | Local |
| Badger | The scheme area provides foraging potential for Badger with the wider environment suitable for sett excavation. | Local |
| Bats | The river corridor is suitable for commuting and foraging bats | Local |
| Marine Mammals | There is the potential for marine mammals to commute through estuary within close proximity to the scheme area. | National |
| Otter | There is the potential for Otter to commute through the Rhymney and forage within the intertidal areas. No suitable holt/lay-up habitat is present within the site. | Local |

### Potential Construction Impacts

***Protected sites***

5.5.3 There is the potential for the construction of the flood defences to impact upon the features of the Severn Estuary European Marine Site through direct loss of habitats, disturbance or changes in water quality. Any impacts to habitats outside of the site boundary also have the potential to impact upon features of the site and this is also considered.

5.5.4 The intertidal mudflats and areas of saltmarsh provide foraging and roosting habitat for a range of wintering wildfowl and wading bird species, many of which are qualifying features of the Severn Estuary EMS. Data obtained from the BTO and detailed in section 5.3 indicate that the mudflats and saltmarsh surrounding the works area are utilised by significant populations of bird species that are qualifying features of the Severn Estuary MS. There is, therefore, the potential to disturb these species associated with the Severn Estuary Ramsar, SPA and SSSI if the works are carried out in the wintering period. Higher risk areas have been identified as works locations 11, 21 and 22. There is a significant construction phase risk in these areas of disturbance to birds using the saltmarsh that have been identified as high tide roosts.

5.5.5 Intertidal habitats directly impacted by the scheme comprise steep sections of the river bank on the outside of the bends and it is not considered that these areas provide foraging or roost potential for bird species associated with the protected site. The permanent works within the SAC boundary will be limited to the replacing existing imported rock with similar new imported rock. However, plant movement in the intertidal area has the potential to negatively impact intertidal habitats through compaction of the foreshore.

5.5.6 There is also the potential to negatively impact intertidal and subtidal habitats through pollution incidents during the construction works.

5.5.7 Section 11 of the proposed flood defence extends into the Rumney and Peterstone

SSSI. The area that will be directly impacted upon is part of the landfill site that has since been allowed to naturalise. In the footprint of the works, the area consists of semi-improved grassland with pockets of dense scrub. It is therefore, not considered that the scheme will directly impact upon the features of the SSSI, however, impacts to the habitats are considered below and impacts to features of the site are likely to be limited to potential pollution incidents during the construction works.

5.5.8 The Rhymney River is designated as a SINC for a range of migratory fish, Otter and bankside habitats. Sites suitable for resting Otter were not identified during site surveys and impacts to the species will be limited to disturbance impacts throughout the construction.

5.5.9 Several SINCs are located on the eastern bank of the Rhymney River including an area of saltmarsh habitat at the southern extent of the river. The works will not directly impact upon these sites, however, there is the potential for haul roads to be required through these areas which would cause direct damage to the SINC.

***Habitats***

5.5.10 Table 5-6 details the intertidal habitats that will be impacted upon by the works footprint. The scheme will directly impact approximately 7.96ha of intertidal habitat in the Severn Estuary and Rhymney River 3.34 ha of which is considered to qualify as annex 1 habitat. However, there is the potential for impacts to intertidal habitats outside of this area through plant movement and site compounds. Table 5-6 details the maximum areas of habitat that may be impacted upon during the construction of the scheme.

5.5.11 Within the Severn Estuary the works will largely be concentrated on areas of existing placed rock which hold little biodiversity value and impacts to this area during the construction of the scheme are not considered to be significant. However, the scheme will directly impact 0.45 ha of saltmarsh and has the potential to further impact saltmarsh and intertidal mudflats in the Rhymey and the Severn through the provision of access tracks.

5.5.12 To further reduce the impact of the scheme a 'soft' engineering design has been utilised to allow the placement of intertidal mud back on top of the flood defences. In order to facilitate the accretion of mud, brushwood will be utilised at regular intervals as detailed in the previous chapter. There will therefore be a period when the mudflat will not function as a fully coherent habitat, and it is uncertain whether this will impact the potential for benthic invertebrates to colonise.

5.5.13 Further riverine habitats adjacent to the Rhymney will be subject to temporary disturbance throughout the construction of the scheme consisting of areas of saltmarsh, reedbeds, dense scrub and semi-improved grassland. These impacts will be relatively small-scale and temporary and therefore not considered to be significant. Impacts to protected species associated with these habitats are considered below.

***Invertebrates***

5.5.14 The intertidal mudflats in this area support a range of macroinvertebrate assemblages which provide a food source for a range of bird and fish species. Damage and disturbance to these habitats through the movement of vehicles and construction plant will result in the killing of any macroinvertebrates present. Given the large amount of similar habitat locally it is considered that recolonisation of these areas will be rapid once works have been completed. Impacts arising through the permanent loss of intertidal mud habitats are considered in the operational impacts section below.

5.5.15 Temporary disturbance and damage to saltmarsh and terrestrial ruderal habitats has the potential to negatively impact upon terrestrial species such as Shrill Carder Bee.

***Fish***

5.5.16 The Severn Estuary and Rhymney River SINC are designated for a range of migratory fish species and a number of these were for migratory species that are likely to spawn further up the Rhymney River or in other rivers higher up in the Severn Estuary.

5.5.17 Mobilisation of sediments and changes to the turbidity of the water column during the construction works have the potential to impact upon fish species.

5.5.18 Pollution incidents such as fuel spills and release of ground contaminants during the construction of the scheme have the potential to impact fish species.

5.5.19 Any works to sub-tidal areas have the potential for impact to fish species.

5.5.20 Whilst no piling will take place below Highest Astronomical Tide (HAT) there is the potential risk of disturbance to migratory fish from working practices that will cause vibrations within the water column e.g. percussive piling.

***Birds***

5.5.21 The intertidal mudflats and areas of saltmarsh provide foraging and roosting habitat for a range of wintering wildfowl and wading bird species, many of which are qualifying features of the Severn Estuary protected site. Data obtained from the BTO and detailed in section 5.3 indicate that the mudflats and saltmarsh surrounding the works area are utilised by significant populations of bird species that are qualifying features of the Severn Estuary protected sites. There is therefore the potential to disturb these species should the project impact upon the foreshore areas.

5.5.22 Re-routing the Wales Coastal path either temporarily or permanently has the potential to disturb wintering and migratory birds if the path results in walkers breaking the skyline.

5.5.23 A HRA will further assess the potential for a significant effect on the bird qualifying features of the European designated sites.

5.5.24 Any clearance of terrestrial scrub or reedbed habitats to facilitate the works has the potential to impact breeding bird species if carried out during the bird nesting period (March to September) through nest damage/destruction and potential disturbance to Schedule 1 species such as Cetti's Warbler. Impacts to riverine habitats also have the potential to impact schedule 1 species such as Kingfisher.

***Reptiles***

5.5.25 There are records for Grass Snake and Slow Worm within the 2km of the scheme area, with records for Slow Worm located between the River Rhymney and the Lamby Way Refuse Site. It is also likely that Common Lizard are present within the scheme area. Areas of dense scrub bounding the river have the potential support a number of species of reptiles. Impacts to these areas will be limited to the construction of access tracks. There is the potential to also impact reptile species during vegetation clearances.

***Otter***

5.5.26 It is likely that Otter will pass through the works area. Scrub and reedbed habitat set

back from the Rhymney River and within Parc Tredelerch have the potential to provide resting sites and holt sites for Otter.

5.5.27 These habitats will not be impacted upon by the works and therefore, impacts are considered to be limited to the temporary disturbance of Otter during the construction period. The banks of the River Rhymney are unlikely to provide suitable habitat for resting sites or holts.

***Marine mammals***

5.5.28 Records for Common Porpoise and Grey Seal suggest that a limited number of these species commute or forage infrequently in the area of the works, with the potential for other species of marine mammal within the wider Severn Estuary. Although the mudflats have the potential to be utilised by seals for hauling out and basking, this is considered unlikely due to the highly industrial and noisy nature of the area.

5.5.29 Impacts from the works are therefore likely to be restricted to temporary noise disturbance to a few foraging and commuting individuals. However, seals hearing can be damaged by piling operations and this can also interfere with cetacean sonar.

***Invasive non-native species***

5.5.30 Japanese Knotweed is abundant along the roadsides of Lamby Way and Rover Way. It is anticipated that the risk of the spread of this species will be limited to any access tracks constructed along the western bank of the River Rhymney.

### Potential Operational Impacts

***Protected sites***

5.5.31 There is the potential for the flood defences, once completed, to impact upon the features of the Severn Estuary EMS through direct loss of habitats. Any impacts to habitats outside of the site boundary also has the potential to impact upon features of the site and this will be considered.

5.5.32 A HRA with regards to the Severn Estuary European Marine Site has also been completed.

5.5.33 Direct habitat losses attributed to the footprint of permanent works and maximum potential direct habitat loss attributed to the works area (plant movement and site compounds) were calculated using GIS software. Datasets for intertidal SAC and saltmarsh habitats were loaded into GIS and overlain with the permanent and temporary works boundaries. The footprint of impacted habitat was then calculated. The impact to saltmarsh habitat was split between Annex I (Atlantic Salt Meadows) and non-Annex I (Other) communities.

**Table 5-6: Total intertidal habitats impacted including construction impacts**

| | Total | Intertidal Annex 1 habitat (within SAC) | Intertidal Annex 1 habitat (outside SAC) | Atlantic Salt Meadows | Other saltmarsh | Other Estuarine Feature (existing flood defences and rubble) |
|---|---|---|---|---|---|---|
| Permanent works | 7.96 | 1.41 | 0.94 | 0.91 | 0.68 | 4.02 |
| Temporary Works | 36.78 | 5.72 | 1.98 | 1.85 | 2.02 | 25.22 |

5.5.34 Maintaining the existing alignment of the coastline through the provision of new hard defences has the potential to cause coastal squeeze. By renewing the defence in this area, it can be considered that a 'hold the line' approach is being taken. As sea levels rise intertidal habitats 'migrate' landwards, there is the potential that this will lead to intertidal habitats being 'squeezed' against the hard defence and eventually lost. Calculations carried out by JBA Consulting have estimated the total intertidal habitat lost as a result of the scheme to be 1.75 Ha. These calculations were carried out using an inundation methodology as set out in Welsh Government guidance[24].

**Table 5-7: Coastal Squeeze losses at each epoch**

| Epoch | Coastal Squeeze losses (Intertidal and saltmarsh, ha) |
|---|---|
| 2021 | 0 |
| 2025 | 1.14 |
| 2055 | 1.29 |
| 2105 | 1.64 |
| 2115 | 1.75 |

5.5.35 The intertidal mudflats and areas of saltmarsh provide foraging and roosting habitat for a range of wintering wildfowl and wading bird species, many of which are qualifying features of the Severn Estuary EMS. Habitat permanently lost, degraded or fragmented following completion of the works has the potential to negatively impact the biodiversity value and in turn impact foraging and wading bird species.

5.5.36 Annex I intertidal mudflat habitat directly, permanently impacted by the scheme comprise steep sections of the river bank on the outside of the bends and it is not considered that these areas provide foraging or roost potential for bird species associated with the protected site. The permanent works within the SAC boundary will be limited to the replacing existing flood defence with similar rock defence.

5.5.37 The scheme is adjacent to the Rumney and Peterstone SSSI. However, it is considered unlikely that the proposed works will have a significant impact upon the interest features of the site following their completion.

***Habitats***

5.5.38 The scheme will utilise a soft engineering approach to replace as much of the intertidal mudflats as possible. However, the scheme will result in the permanent loss of

[24] Environment Agency, 2021. *What is Coastal Squeeze?*. [online] Available at: <https://assets.publishing.service.gov.uk/media/6038fafde90e07055c14049b/FRS17187_What_is_coastal_squeeze_-_report__1_.pdf

approximately 3.34ha of intertidal habitat that qualifies as annex1 habitat both within the Rhymney and the Severn Estuary

5.5.39 Within the Severn Estuary the works will largely be concentrated on areas of existing placed rock which hold little biodiversity value and impacts to this area are not considered to be significant. However, the scheme will directly impact 0.45 ha of saltmarsh within the Severn Estuary EMS. Areas of saltmarsh that have been identified as high tide roosts by NRW will not be permanently impacted upon by the scheme.

5.5.40 To further reduce the impact of the scheme a 'soft' engineering design has been utilised to allow the placement of intertidal mud back on top of the flood defences. In order to facilitate the accretion of mud brushwood will be utilised at regular intervals as detailed in the previous chapter. This will therefore be a period when the mudflat will not function as a fully coherent habitat and it is uncertain whether this will impact the potential for benthic invertebrates to colonise. As detailed in section 4 this will result in a shallower angle and has the potential to increase the value of the mudflat habitat in these areas.

5.5.41 However, maintaining the existing alignment of the coastline through the provision of new hard defences has the potential to cause coastal squeeze. By renewing the defence in this area, it can be considered that a 'hold the line' approach is being taken. As sea levels rise intertidal habitats 'migrate' landwards, there is the potential that this will lead to intertidal habitats being 'squeezed' against the hard defence and eventually lost. Appropriate compensation habitat will be required in order to enable the project to proceed. Compensatory habitat for this scheme has already been provided for under the National Habitat Creation Programme NHCP.

5.5.42 A HRA with regards to the Severn Estuary EMS has also been completed.

***Invertebrates***

5.5.43 The intertidal mudflats in this area support a range of macroinvertebrate assemblages which provide a food source for a range of bird and fish species. Any permanent loss of this habitat will result in the loss of benthic invertebrates. However, given the small-scale loss of this habitat it is not considered that impacts to invertebrate populations will be significant. The impact upon the loss of this food source specific to the scheme location is considered below.

5.5.44 Saltmarsh that will be directly lost as part of the scheme consists of scattered remnants of historic saltmarsh and it is not considered that the loss of saltmarsh in this area will have a significant impact upon terrestrial invertebrates following completion.

5.5.45 The continuity and integrity of the saltmarsh that connects the Gwent levels SSSI and the Severn Estuary SSSI will not be directly impacted upon by the scheme following completion. However, there is the potential for future coastal squeeze to impact this area resulting in continued loss invertebrate habitat. Therefore, monitoring of the saltmarsh, including insect populations will be carried out as part of the scheme.

***Fish***

5.5.46 It is not considered that the scheme will have an impact upon fish throughout the operational lifetime.

***Birds***

5.5.47 The scheme will not have an impact upon birds throughout the operational lifetime.

5.5.48 A HRA will further assess the potential for a significant effect on the bird qualifying features of the European designated sites.

***Reptiles***

5.5.49 The scheme will not have an impact upon reptiles throughout the operational lifetime.

***Otter***

5.5.50 No permanent impacts on Otter are anticipated during the operation of the scheme.

***Marine mammals***

***5.5.51*** The scheme will not have an impact upon marine mammals throughout the operational lifetime

***Invasive non-native species***

5.5.52 The scheme will not facilitate the spread of INNS throughout the lifetime of the scheme.

5.5.53

**Table 5-8: Potential impacts and likely significant effects to valued ecological receptors in the absence of mitigation**

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| Severn Estuary SAC | | | | |
| | Damage, or loss of intertidal habitats that the area is designated for during the construction and operation phases due to the placement of rock armour within designated site boundary.<br>Works within the Severn Estuary SAC will for the most part place more rock in areas of existing rock flood defence or historically discarded building materials.<br>The works footprint will impact approximately:<br>3.4ha of habitat within the SAC.<br>2.9 ha of this consists of existing rock defences and discarded building materials.<br>0.45 ha consists of existing saltmarsh. | Permanent negative effect at international scale | For the most part the new rock revetment will be placed in areas of existing rock flood defence or historically discarded building materials.<br><br>Compensatory habitat for this scheme has already been provided for under the Welsh Government habitat creation scheme. | **Small scale impact at the local scale.** |
| | Damage, or loss of intertidal habitats brought about by maintaining the existing alignment of the coastline through the provision of new hard defences (i.e. coastal squeeze). | Permanent negative effect at international scale | Compensatory habitat for this scheme has already been provided for under the Welsh Government habitat creation scheme. | **Small scale impact at the local scale.** |
| | Piling operations associated with the works have the potential to elicit behavioural impacts on migrating fish species of importance passing through the area. | Temporary negative effect at national scale | All Piling works will be undertaken in the dry above HAT.<br><br>Vibration piling (using a variable moment vibrator and a 'soft start' approach) should be used wherever possible. It is proposed that this will be the preferred method of piling and percussive piling will only be used where this method has failed. | **No significant negative effect on the extent, distribution or conservation status of the species** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | | | Percussive piling works within 30m of the HAT during the migration period will only be undertaken during the falling tide of the river (high tide plus one hour and low tide minus one hour). Should percussive piling be required during the migration period outside the time constraint identified, it will be necessary to agree mitigation measures with NRW prior to any such works taking place. | |
| Severn Estuary SPA and Ramsar<br>Severn Estuary SPA and Ramsar | Direct damage to maritime habitats via pollution and run-off. | Temporary negative effect at international scale | Industry standard construction practices as detailed in the construction management plan.<br><br>All machinery to be in good condition and to be checked daily to prevent pollution incidents.<br><br>Drip trays will be used to prevent oil leaking from machinery when parked/stored, and during refuelling of machinery. If fuel spillages happen due to refuelling, they will be carefully contained, to ensure they will not be released into the estuary. Where there is potential for pollutants to be escape in drainage water, this will be collected, passed through settlement and oil interception facilities to remove pollutants before being discharged to the estuary.<br><br>A Construction Environmental Management Plan (CEMP) will be produced during the pre-construction period and implemented during construction period to minimise the risk of pollution events occurring.<br><br>The application of good practice construction methodology, through the implementation of a CEMP to control the use and storage of potentially contaminating materials and litter, will further avoid any likely significant effects on coastal habitats during the construction phase. | **No significant negative effect on conservation status of the site** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | | | An Ecological Clerk of Works (ECoW) will be appointed to oversee this | |
| | Damage, or loss of intertidal habitats within the Severn Estuary during the construction and operation phases due to the placement of rock armour within designated site boundary.<br>The works footprint will impact approximately 0.45 ha of saltmarsh that has the potential to be utilised by migratory and wintering bird species. | Permanent negative effect at international scale | For the most part the new rock revetment will be placed in areas of existing rock flood defence or historically discarded building materials. Compensatory habitat for this scheme has already been provided for under the Welsh Government habitat creation scheme. | **Small scale impact at the local scale.** |
| | Damage, or loss of intertidal habitats within the Rhymney Estuary during the construction and operation phases due to the placement of rock armour within designated site boundary.<br>Where possible a 'soft' engineering design has been utilised to allow the placement of intertidal mud back on top of the flood defences. | Permanent negative effect at international scale | Alignment of the scheme has been designed to minimise habitat removal and fragmentation. Intertidal habitats directly impacted by the scheme comprise steep sections of the river bank on the outside of the bends. It is not considered that these areas provide foraging or roost potential for bird species associated with the protected site. Bird survey data obtained through surveys reveals that the areas identified to be lost are not utilised by migratory or wintering bird species.<br><br>Areas of saltmarsh that have been identified as high tide roosts by NRW will not be impacted upon by the scheme.<br><br>Impacts will also be assessed within the HRA. | **Small scale impact at the international scale.** |
| | Damage, or loss of intertidal habitats brought about by maintaining the existing alignment of the coastline through the provision of new hard defences (i.e. coastal squeeze). | Permanent negative effect at international scale | Direct and indirect habitat losses will be compensated through the National Habitat Creation Programme NHCP | **Small scale impact at the local scale.** |
| Annex I priority and designated feature | Disturbance to overwintering and migratory bird species | Temporary negative effect at international scale | Sensitive areas adjacent to the Rhymney and Severn Estuaries have been identified and will be subject to a 2 hour tidal restriction either side of high tide to avoid | **No significant negative effect on** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| habitats – Severn Estuary | | | impacts on birds utilising these habitats at high tide. This will be monitored by an ECoW. | **conservation status of the site** |
| Annex I priority and designated feature habitats – Severn Estuary | Damage, disturbance, degradation, or loss of coastal and aquatic habitats, including intertidal mudflat, saltmarsh, rocky shore, and river habitats during the construction and operation phases due to the placement of rock armour and scour protection on intertidal habitats.<br>Permanent loss of intertidal habitat and the separation of saltmarsh from intertidal areas may occur as a result of the scheme.<br>Future habitat loss may also occur as a result of changes in coastal/fluvial erosion and coastal squeeze from sea level rise. | Permanent negative effect at international scale | For the most part the new rock revetment will be placed in areas of existing rock flood defence or historically discarded building materials.<br><br>Compensation for all intertidal habitats impacted by the scheme will be delivered through the National Habitat Creation Programme managed by NRW. | **Yes** |
| Annex I priority and designated feature habitats – Rhymney River | Damage, disturbance, degradation, or loss of coastal and aquatic habitats, including intertidal mudflat, saltmarsh, rocky shore, and river habitats during the construction and operation phases due to the placement of rock armour and scour protection on intertidal habitats.<br>Permanent loss of intertidal habitat and the separation of saltmarsh from intertidal areas may occur as a result of the scheme.<br>Future habitat loss may also occur as a result of changes in coastal/fluvial erosion and coastal squeeze from sea level rise. | Permanent negative effect at international scale | Alignment of the scheme has been designed to minimise habitat removal and fragmentation. Intertidal habitats directly impacted by the scheme comprise steep sections of the river bank on the outside of the bends.<br><br>Areas of saltmarsh within the Rhymney will not be impacted upon by the scheme.<br><br>As part of the scheme the area of saltmarsh identified as degraded in the NVC detailed above will be improved by the discouragement of horse grazing.<br><br>Impacts will also be assessed within the HRA. | **Small scale impact at the international scale.** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| Gwent Levels: Rumney and Peterstone | Direct damage to habitats via pollution and run-off. | Temporary negative effect at international scale | Industry standard construction practices as detailed in the construction management plan.<br><br>All machinery to be in good condition and to be checked daily to prevent pollution incidents.<br><br>Drip trays will be used to prevent oil leaking from machinery when parked/stored, and during refuelling of machinery. If fuel spillages happen due to refuelling, they will be carefully contained, to ensure they will not be released into the estuary. Where there is potential for pollutants to be escape in drainage water, this will be collected, passed through settlement and oil interception facilities to remove pollutants before being discharged to the estuary.<br><br>A Construction Environmental Management Plan (CEMP) will be produced during the pre-construction period and implemented during construction period to minimise the risk of pollution events occurring.<br><br>The application of good practice construction methodology, through the implementation of a CEMP to control the use and storage of potentially contaminating materials and litter, will further avoid any likely significant effects on coastal habitats during the construction phase.<br><br>An Ecological Clerk of Works (ECoW) will be appointed to oversee this | **No significant negative effect on conservation status of the site** |
| Nesting birds | Disturbance to neting bird species | Temporary negative effect at local scale | Any clearance of scrub, woodland or grassland habitats has the potential to impact nesting birds through damage/destruction of nests and potential disturbance of Schedule 1 birds. | **No significant negative effect on the extent, distribution or conservation status of the species** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | | | Loss or damage to habitat due to coastal squeeze due to the operation of the scheme will affect foraging and roosting behaviour. | |
| | | | | |
| Wintering and migratory birds including Severn Estuary EMS assemblage | See impacts to Severn Estuary SPA | | | |
| Fish | Piling operations associated with the works have the potential to elicit behavioural impacts on migrating fish species of importance passing through the area. | Temporary negative effect at national scale | All Piling works will be undertaken in the dry above HAT.<br><br>Vibration piling (using a variable moment vibrator and a 'soft start' approach) should be used wherever possible. It is proposed that this will be the preferred method of piling and percussive piling will only be used where this method has failed.<br><br>Percussive piling works within 30m of the HAT during the migration period will only be undertaken during the falling tide of the river (high tide plus one hour and low tide minus one hour). Should percussive piling be required during the migration period outside the time constraint identified, it will be necessary to agree mitigation measures with NRW prior to any such works taking place. | **No significant negative effect on the extent, distribution or conservation status of the species** |
| | Release of sediments | Temporary negative effect at international scale | As detailed in chapter 4 all excavations will be re-used directly or stored above HAT before being reinstated | **No significant negative effect on the extent, distribution or conservation status of the species** |
| | Direct damage to habitats and fish via pollution and run-off. | Temporary negative effect at international scale | Industry standard construction practices as detailed in the construction management plan.<br><br>All machinery to be in good condition and to be checked daily to prevent pollution incidents. | **No significant negative effect on conservation status of the site** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | | | Drip trays will be used to prevent oil leaking from machinery when parked/stored, and during refuelling of machinery. If fuel spillages happen due to refuelling, they will be carefully contained, to ensure they will not be released into the estuary. Where there is potential for pollutants to be escape in drainage water, this will be collected, passed through settlement and oil interception facilities to remove pollutants before being discharged to the estuary.<br><br>A Construction Environmental Management Plan (CEMP) will be produced during the pre-construction period and implemented during construction period to minimise the risk of pollution events occurring.<br><br>The application of good practice construction methodology, through the implementation of a CEMP to control the use and storage of potentially contaminating materials and litter, will further avoid any likely significant effects on coastal habitats during the construction phase.<br><br>An Ecological Clerk of Works (ECoW) will be appointed to oversee this | |
| Terrestrial habitats | Damage, disturbance, degradation, or loss of species during the construction and operation phases due to the placement of rock armour and scour protection on habitats. | Temporary negative effect at local scale | Alignment of the scheme designed to minimise habitat removal and fragmentation.<br>Replacement of removed habitats, with connectivity to existing habitats. | **Negligible adverse** |
| Otter | Damage, disturbance, degradation, or loss of species during the construction and operation phases due to the placement of rock armour and scour protection on habitats. | Temporary negative effect at local scale | Construction works will not be carried out between sunset and sunrise.<br>During these times, all construction plant will be removed from the river bank. Any site lighting required will be positioned so that no light falls onto the adjacent river bank. The installation of protective fencing around the site compound areas will be undertaken to prevent | **Negligible adverse** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | | | otter from accessing these areas. All excavations will be backfilled on the same day to avoid the risk of otter falling in, or all open excavations over 600mm in depth will be covered at night. If this is not possible, a means of escape for small animals will be provided. Monitoring for signs of otters during works. Should an otter be encountered on site during the works, all works will cease immediately | |
| Bats | Potential severance of commuting routes, from direct damage to commuting, foraging and roosting habitats from vegetation clearance<br>The permanent removal of plantation woodland could adversely impact upon woodland foraging species. | Temporary negative effect at local scale to foraging and commuting habitat. | Avoidance of works during the active season. Vegetation clearance to be undertaken from Dec 2016 - February 2017.<br>Production of a Construction Environmental Management Plan (CEMP). | **No significant negative effect on the extent, distribution or conservation status of the species** |
| Marine Mammals, | Piling operations associated with the works have the potential to disturb marine mammals foraging within the Severn | Temporary negative effect at local scale | It is considered unlikely that the works including piling operations will have a large scale significant effect upon marine mammals, however, as a precautionary measure it is recommended that a 'soft start' approach to the piling works is undertaken. This will allow any marine mammals present in the immediate vicinity of the works to move away and not be damaged by any louder piling noises. | **No significant negative effect on the extent, distribution or conservation status of the species** |
| Reptiles | Killing/injury and/or noise or visual disturbance during the construction phase.<br>Loss or damage to habitat due to the operation of the scheme will affect reptile assemblages. | Temporary negative impact at local scale | Alignment of the Scheme designed to minimise removal of habitat for reptiles.<br><br>Replacement of removed habitat, with connectivity to existing habitats, and enhancement of existing habitats.<br>Vegetation clearance undertaken under ecological supervision and toolbox talks will be provided | **Negligible adverse** |
| Amphibians | Killing/injury and/or noise or visual disturbance during the construction phase. | temporary negative impact at local scale | Alignment of the Scheme designed to minimise removal of habitat for amphibians.<br><br>Replacement of removed habitat, with connectivity to existing habitats, and enhancement of existing habitats. | **Negligible adverse** |

| Ecological feature | Potential Impact | Effect without mitigation | Mitigation | Significance of residual effect |
|---|---|---|---|---|
| | Loss or damage to habitat due to the operation of the scheme will affect reptile assemblages. | | Vegetation clearance undertaken under ecological supervision and toolbox talks will be provided . | |
| Terrestrial invertebrates | Loss or damage to habitat due to the operation of the scheme will affect reptile assemblages. | temporary negative impact at local scale | Alignment of the Scheme designed to minimise removal of habitat for terrestrial invertebrates<br><br>Replacement of removed habitat, with connectivity to existing habitats, and enhancement of existing habitats.<br>Vegetation clearance undertaken under ecological supervision. | **Negligible adverse** |
| Marine INNS | Spread of marine INNS during the construction phase will lead to long-term impacts on surrounding area as they outcompete native species. | Permanent negative impact at local scale | INNS method statements with Biosecurity measures must be developed and followed during construction. | **Negligible adverse** |
| INNS | Spread of Japanese Knotweed during the construction phase will lead to long-term impacts on surrounding area as they outcompete native vegetation. | Permanent negative impact at local scale | INNS method statements with Biosecurity measures must be developed and followed during construction. | **Negligible adverse** |

# 6 Landscape

## 6.1 Methodology

### Outline of the assessment process

***Stages and definitions***

6.1.1 The assessment will involve the following key stages:

- Establishing the nature of the existing or 'baseline' landscape character and visual context of the scheme.
- Determination of how the scheme will change the baseline landscape character and visual context, through consideration of specific landscape and visual 'receptors'.
- Assessment and reporting of potential effects, with particular reference to those that are likely to be 'significant'.
- Identification of mitigation to reduce adverse effects.
- Reporting of residual effects, and those that are considered 'significant'.
- For the purposes of LVIA, a clear distinction is made between landscape and visual impacts as follows:
- Landscape impacts are those that may arise from the scheme on physical characteristics or components of the landscape which inform its character, such as landform, vegetation, water courses or perceptual influences.
- Visual impacts are those that relate to changes in the view that may arise from the scheme as experienced by specific 'receptors', such as local residents or users of footpaths.
- Effects will be assessed at the following stages:
- Construction: temporary, relatively short-term works.
- Operational effects at Year 1, i.e. when the facility opens and begins to operate, vegetation has yet to establish and assuming a worst-case 'winter' scenario of not being in leaf.
- Residual effects at Year 15, during the winter.

6.1.2 The process will be supported by the use of viewpoints to illustrate and evaluate effects at key locations relevant to key receptors or receptor groups, but the assessment of effects is not confined to these viewpoints.

***Best practice guidance***

6.1.3 The assessment of landscape and visual effects will be prepared with reference to the following:

- Guidelines for Landscape and Visual Impact Assessment, 3rd edition (GLVIA3). The Landscape Institute and the Institute of Environmental Management and Assessment, 2013.
- An Approach to Landscape Character Assessment. Christine Tudor, Natural England, October 2014.
- Landscape Institute Technical Guidance Note TGN 06/19: Visual Representation of development proposals.
- Landscape Institute Technical Guidance Note TGN 02/21: Assessing landscape value outside national designations.

***Assessment terminology***

6.1.4 In order to determine the scale of effects, two key aspects should be established. These are the nature of the landscape or visual receptor likely to be affected, often referred to as its sensitivity, and the nature of the effect likely to occur, which is often referred

to as the magnitude of the likely change. These two results are combined to form a judgement of the scale of the effect. Consideration of the scale of the effect then enables a judgement to be made as to whether the effect is significant.

***Professional judgement***

6.1.5 GLVIA3 recognises that professional judgement is an important concept within LVIA. Whilst there is scope for quantitative measurements of some factors, in many situations the assessment must rely on qualitative judgements that are based on reasoned and informed justifications.

***Limitations of the assessment***

6.1.6 The assessment and the prediction of effects during the life-span of the proposals are based on the available background information and information regarding the proposals, and involve a degree of informed professional judgement.

***Planning policy***

6.1.7 See Section 2.7, Chapter 2 for details of the national and local planning policy which forms the framework for this assessment.

***Assessment of residential receptors***

6.1.8 The assessment of visual effects on residential receptors is an outline assessment only, and is not a detailed Residential Amenity Assessment.

***Timing of surveys***

6.1.9 The effects of screening by vegetation will need to be considered depending on the timing of survey work. Where deemed relevant, consideration of seasonal vegetation will be given within the assessment.

### Determining the scope of the study

6.1.10 The scope of the LVIA will be defined by desk-based research and site survey work. Key matters reviewed in determining the scope:

- The extent of the study area.
- Sources of relevant landscape and visual information.
- The nature of the possible landscape and visual effects.
- The main receptors and any specific viewpoints.
- The extent and appropriate level of detail for the baseline studies to be proportionate to the scale and type of development proposed.

***Viewpoints***

6.1.11 A viewpoint is a location from where a view of the proposal may be gained; a number of viewpoints will be chosen in order to support the assessment of landscape and visual effects and illustrate effects at key locations for key receptors.

6.1.12 The viewpoints are carefully selected to be either:

- **Representative viewpoints**: those selected to represent the experience of different types of visual receptors, where a large number of viewpoints cannot all be included individually and where notable effects are unlikely to differ. For example, viewpoints may be chosen to

represent views for users of a number of footpaths or bridleways. Viewpoints may also be selected to reflect visual elements that inform the landscape resource.

- **Specific viewpoints**: important key viewpoints within the landscape. Examples of these may include local visitor attractions, settlements, routes valued for their scenic amenity, or places with cultural landscape associations.
- **Illustrative viewpoints**: those chosen specifically to demonstrate a particular effect or specific issues, e.g. restricted visibility at certain locations.

6.1.13 Viewpoints are initially selected as those places from where a proposed development is likely to be visible and would result in notable effects on the view and the receptors. This is informed by maps, fieldwork observations and information on other relevant issues such as access, landscape character and popular vantage points.

6.1.14 A range of views and viewers are represented through the choice of viewpoints. Factors which will be considered in selecting the final viewpoints to be used for the assessment include:

- Landscape character of the area.
- The presence of nationally designated landscapes and/or Areas of High Landscape Value within local planning policy, recreational routes, and local amenity spaces.
- Visual composition, for example focused or panoramic views, simple or complex landscape pattern, vistas or glimpses.
- Distance from the proposed development (short, medium and long-range views).
- Aspect and elevation.
- Viewer type.
- Activities of the receptors, for example those at home, work, travelling in various modes or carrying out recreation.
- Modes of movement, for example whether receptors are moving through the landscape or stationary.

6.1.15 For all viewpoints, photographs were taken with a full-frame sensor digital SLR camera with a 50mm fixed lens (or the cropped-frame equivalent). The camera was tripod mounted in a portrait orientation to minimise distortion. A series of images suitable to stitch together to form a panoramic image were also taken in support of the main viewpoint image, in accordance with TGN 06/19, and the following information was recorded:

- Precise location 12 figure OS grid reference.
- Viewpoint altitude in metres Above Ordnance Datum (m AOD) interpolated from DTM/OS mapping.
- Viewing height in metres.
- Horizontal field of view (in degrees).
- Distance to development.
- Date of assessment.
- Weather conditions and visual range.

***Landscape assessment***

6.1.16 For the purposes of LVIA, the landscape is considered to be a resource in its own right. The European Landscape Convention (2000), which is referenced in GLVIA3, provides the following definition of landscape:

6.1.17 'Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.'

6.1.18 The assessment of landscape effects considers the effects the proposed development will have on this landscape resource.

6.1.19 Landscape effects that may arise include a change, loss or addition of elements, features, aesthetic or perceptual aspects, that contribute to the distinctiveness or character of the landscape.

***Establishing the landscape baseline***

6.1.20 To enable the assessment of the effects of a proposed development or change, the landscape baseline must be established. This enables the identification of landscape receptors and the effects of the proposed changes on these landscape receptors to be considered. The landscape baseline studies consider the following:

- Landscape features – physical landscape elements present within the landscape such as landform, land cover, boundary features and trees and woodland. In other words, physical elements that make up the landscape we see, and that may be affected during the construction, operation and decommissioning of the proposed development.
- Landscape character – the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement, but also encompasses its perceptual and aesthetic qualities. It creates the particular sense of place of different areas of the landscape. Assessment of the effect of the development on landscape character is a crucial element of the landscape assessment.

6.1.21 These studies enable a list of potential landscape receptors to be compiled.

***Determining landscape sensitivity***

6.1.22 The next stage is to determine the sensitivity of the landscape receptors to the type and scale of development proposed. In order to do this, the susceptibility and value of the receptor are considered, although within the assessment these may not always be explicitly noted. In many cases, it is considered sufficient to describe only the sensitivity, which is informed by an overall professional judgement.

6.1.23 Susceptibility is the "ability of the landscape receptor (whether it be the overall character of quality/condition of a particular landscape or area, or an individual element and/or feature or a particular aesthetic or perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline and/or the achievement of planning policies and strategies." (GLVIA3).

6.1.24 Where noted, susceptibility is described as follows:

- High – where undue negative consequences are expected to arise from the proposals.
- Medium – where undue negative consequences may arise from the proposals.
- Low – where undue negative consequences are unlikely to arise from the proposals.

6.1.25 Susceptibility may be informed by existing Landscape Character Assessments, which often note sensitivity. However, this is frequently 'intrinsic' or 'inherent' sensitivity, which may not directly relate to the type of development proposed. In such cases, a judgement must be made as to how this sensitivity might relate to the development in question.

6.1.26 The value of a landscape receptor is informed by designations, planning policy and documents, the contribution of special (cultural, historic or conservation) contributors or associations, scenic quality, rarity, recreational value and aesthetic, perceptual and experiential qualities. These are again reinforced by judgements, particularly where no designations are established. Conversely, care should be taken not to rely on designations as the sole indicator of value; this should be reinforced by rationale where necessary. Where noted, value is described as follows:

- High – landscapes with national or international designations on account of landscape value, such as National Parks, Areas of Outstanding Natural Beauty, Heritage Coasts or World Heritage Sites; landscapes informed by presence of significant heritage designations.
- Medium – landscapes of regional/local value, subject to local Planning policy protection (such as Areas of High Landscape Value), or undesignated areas where it is considered that particular features are more valued and/or appreciation of the landscape is greater than other nearby areas.
- Low – landscapes that are not subject to designation and may be valued only at a community or local level.

6.1.27 It should be noted that 'undesignated' landscapes and the value which should be attributed to them is a complex area, potentially subject to a number of contributory factors. Landscapes that are not valued but offer visual and amenity value to local communities may not necessarily be of low sensitivity. Reference has been made within this assessment to TGN 02-21 (Landscape Institute) in assessing value.

6.1.28 Landscape sensitivity combines the judgements made for susceptibility and value, as described above. Three levels of sensitivity are recorded:

- High sensitivity – a landscape of high value and a particularly distinctive character that is susceptible to relatively small changes of the type proposed.
- Medium sensitivity – a landscape of valued characteristics reasonably tolerant to change of the type proposed.
- Low sensitivity – a landscape of relatively low value or importance which is potentially tolerant of substantial change of the type proposed.

***Other landscape considerations***

6.1.29 The considerations noted above are further informed by general observations regarding the condition and quality of the landscape. These support the overall narrative and judgement of sensitivity. Landscape quality or condition may relate to the level of management, distinctiveness, number of detracting features, pattern, unity, structure, sense of place, function, and aesthetic value.

6.1.30 Areas of landscape quality may not necessarily correlate directly with landscape character areas or designated sites as defined by statutory agencies or local planning authorities. Where it is considered that this is the case, mention is made within the description and sensitivity evaluation.

***Magnitude of landscape change***

6.1.31 Effects on landscape receptors are assessed in terms of their magnitude of change. This is a combination of the size or scale, geographic extent of the area influenced, and the duration and reversibility of the impact. Within the assessment, size and scale or extent may not always be noted. In many cases, it is considered sufficient to describe only the magnitude of change, which is informed by an overall professional judgement.

6.1.32 Definitions of size and scale concern the amount of existing landscape elements that will be lost, and the extent to which these represent or contribute to the character of the landscape. It also relates to the degree to which aesthetic or perceptual aspects of the landscape are altered through removal or addition of new features, such as hedge loss, or the introduction of tall features on skylines.

6.1.33 Size and scale, where noted, may be rated as follows:

- Large – major change to the existing landscape including key elements, characteristics and qualities.
- Medium – partial or noticeable change to key elements, characteristics and qualities.
- Small – some discernible but largely minor change to key elements, characteristics and qualities.
- Negligible – very minor or virtually imperceptible change to key elements, characteristics and qualities.

6.1.34 The geographical extent over which landscape effects are felt is distinct from the size or scale. Again, extent is subject to a degree of professional judgement, but where noted these are described as follows:

· Wide – influencing several landscape types or areas, beyond around 5km.

· Medium – generally within the local character area, or between 1 and 5km.

· Local – the site and immediate surrounds, up to around 0.75 to 1km.

· Site – within around 0.75km of the site.

6.1.35 The duration of the effect relates to the time period during which the changes to the landscape will occur. This may be rated as follows:

· Long-term – beyond 10 years.

· Medium-term – 2 to 10 years.

· Short-term – up to 2 years.

6.1.36 Consideration should also be given as to whether the change is temporary or permanent.

6.1.37 The magnitude of change is a product of the size/scale, extent, and duration of the impacts. This is judged as follows:

- High – notable and long-term change in landscape characteristics over an extensive area, or a very intensive, long-term change over a more limited area.
- Medium – moderate, short term change over a large area, or moderate long-term change in a localised area.
- Low – slight long-term or moderate short-term change in landscape components.

- No change/negligible – no discernible change to landscape character or features.

6.1.38 Within the assessment, size and scale or extent may not always be noted. In many cases, it is considered sufficient to describe only the magnitude of change, which is informed by an overall professional judgement.

***Visual assessment***

6.1.39 Visual effects relate to how the development may affect the views available to people and their visual amenity. Visual amenity is the visual quality of a site or area as experienced by residents, workers or visitors. Visual receptors are people that experience the view. Development can change people's direct experience and

perception of the view depending on existing context, scale, form, colour and texture of the proposals, the nature of the activity associated with the development, the distance and angle of view.

***Establishing the visual baseline***

6.1.40 Identification of potential visual receptors is informed by desk and field studies to pinpoint places where people might be expected to receive a view of the proposed development. Once receptors have been identified, it is necessary to document the following information, though the degree of detail required will vary depending on the nature of the receptor and the view experienced:

- Type, relative numbers, and activities of potential receptors.
- The nature, composition, and characteristics of the existing views. This might include the nature and extent of the skyline, aspects of vertical scale and proportion, key foci, and elements which interrupt, filter, or otherwise influence the view.

***Determining visual receptor sensitivity***

6.1.41 In order to determine the scale of visual effects, it is necessary, as with the assessment of landscape effects, to determine the sensitivity of the receptor. This is achieved through the consideration of the susceptibility of the receptor to the changes proposed, and the value of the view. Within the assessment, susceptibility and value may not always be noted. In many cases, it is considered sufficient to describe only the sensitivity, which is informed by an overall professional judgement.

6.1.42 Visual receptor susceptibility is a function of receptor type, location and activity. In assessing visual receptor susceptibility, factors such as the following have been considered:

- Receptor activities – whether receptors are at home, undertaking leisure, recreational and sporting activities, or at work.
- Movement/duration – whether receptors are likely to be stationary or moving, a factor which influences how long they will be exposed to the change.
- Orientation – in which direction receptors are likely to be facing in relation to the development.
- Purpose/expectation – whether receptors might be likely to expect to experience the particular change at that location.
- Context – the quality of the landscape.
- Importance of the view/location – known viewpoints within landscape designations or ares of local value.

6.1.43 The value of the view that is experienced by receptors may relate to associated landscape or planning designations, cultural references or the presence of facilities (car parking, interpretation boards, signage) that may emphasise the importance of that landscape.

6.1.44 Visual receptor sensitivity is then judged as a combination of susceptibility and value and is reported as follows:

- High – receptors visiting promoted or valued viewpoints especially those with panoramic views; visitors to heritage or tourism sites where views are important; receptors visiting viewpoints noted within planning guidance or policy; receptors using public rights of way, particularly those receiving high numbers of visitors, or those that are heavily promoted; receptors at home in residential properties.

- Medium – receptors travelling along cycle routes or local roads particularly those in rural areas where speeds are slower.
- Low – receptors that are fast-moving (due to speed on roads and motorways) or those that are engaged in an activity not concerned with the landscape or view (such as work or sport).

6.1.45 As with all aspects of the methodology, these definitions are not rigid, and a degree of professional judgement may be applied within the assessment when reporting visual sensitivity.

***Visual receptor magnitude of change***

6.1.46 The assessment of the magnitude of change for visual receptors follows similar principles to landscape assessment in terms of size or scale, the geographic extent of the area influenced, and its duration and reversibility. Within the assessment, not all aspects may be reported. In many cases, it is considered sufficient to describe only the magnitude of change, which is informed by an overall professional judgement.

6.1.47 The description of size and scale concern the relative change in the elements, features, qualities and characteristics that make up the view.

6.1.48 Size and scale, where noted, are stated as:

- Large – major change to the existing view including key elements, characteristics and qualities.
- Medium – partial or noticeable change to elements, characteristics and qualities within the view.
- Small – some discernible but largely minor change to key elements, characteristics and qualities within the view.
- Negligible – very minor or virtually imperceptible change to key elements, characteristics and qualities, such that the view essentially remains unchanged.

6.1.49 The geographical extent over which visual effects are described is recorded as follows:

- Wide – influencing most of a view (over half).
- Medium –generally influencing between one quarter to one half of a view.
- Small – generally influencing less than one quarter of a view.
- Limited – generally influencing only a small part of the view.

6.1.50 The duration of the effect relates to the time period during which the changes to the view will occur. This would be rated as follows:

- Long-term – beyond 10 years.
- Medium-term – 2 to 10 years.
- Short-term – up to 2 years.

6.1.51 The magnitude of change is a product of the size/scale, extent and duration of the impacts. These would be judged as follows:

- High – where the development causes a very significant change in the existing view.
- Medium – where the development would cause a very noticeable change in the existing view.
- Low – where the development would cause a noticeable change in the existing view.
- Negligible/no change – where the development would cause a barely perceptible change at most in the existing view.

## 6.2 Assessment of effects

### Scale of effects

6.2.1 The next step is to determine the scale of effects which is evaluated by considering the sensitivity of the landscape or visual receptor, and the magnitude of change (see the matrix in Table 6-1). The matrix provides an objective rationale for determining the scale of effects, in order to provide consistency and transparency to the process. Again, a degree of professional judgement may also be employed when reaching conclusion on the scale of effects.

**Table 6-1: Scale of effects matrix**

| | | Sensitivity to change (nature of receptors) | | |
|---|---|---|---|---|
| | | ***Low*** | ***Medium*** | ***High*** |
| **Magnitude of Change resulting from impacts identified** | ***No Change/ Negligible*** | Negligible | Negligible | Negligible |
| | ***Low*** | Slight | Slight - Moderate | Moderate |
| | ***Medium*** | Slight - Moderate | Moderate | Moderate - Substantial |
| | ***High*** | Moderate | Moderate - Substantial | Substantial |

The scale of effects detailed above can be classed as Beneficial, Neutral or Adverse

### Classification of landscape effects

6.2.2 Adverse landscape effects occur when features or key landscape characteristics such as established planting, old buildings or structures which, when considered singularly or collectively, help to define the character of an area are lost, or where new structures out of scale or character with the surroundings are introduced. The different levels of effect are described as follows:

- Substantial adverse landscape effects occur where the proposals are at considerable variance with the landform, scale and pattern of the landscape and would be a dominant feature, resulting in considerable reduction in scenic quality and large-scale change to the intrinsic landscape character/features of the area.
- Moderate adverse landscape effects occur where proposals are out of scale with the landscape, or inconsistent with the local pattern and landform and may be locally dominant and/or result in a noticeable reduction in scenic quality and a degree of change to the intrinsic landscape character/features of the area.
- Slight adverse landscape effects occur where the proposals do not quite fit with the scale, landform or local pattern of the landscape and may be locally intrusive but would result in a minor reduction in scenic quality or change to the intrinsic landscape character/features of the area.
- Neutral landscape effects arise when the change proposed results in no discernible improvement or deterioration to the landscape resource. The proposals are in keeping with the scale, landform and pattern of the landscape, and / or would not result in any discernible reduction in scenic quality or change to the intrinsic landscape character of the area.
- In contrast to the above adverse effects, beneficial landscape effects occur where derelict buildings, land or poorly maintained landscape features are repaired, replaced, or where new positive features are introduced, such as new tree planting which helps to define landscape structure where none currently exists.

### Classification of visual effects

6.2.3 Adverse Visual Effects occur when the proposed development will introduce new, non-characteristic, discordant or intrusive elements into views for receptors. The different levels of effect are described as follows:

- Substantial adverse visual effects occur where the proposed development would cause a considerable deterioration in the existing view or visual amenity.
- Moderate adverse visual effects occur where the proposed development would cause a noticeable deterioration in the existing view or visual amenity.
- Slight adverse visual effects occur where the proposed development would cause a barely perceptible deterioration in the existing view or visual amenity.
- Neutral visual effects occur where the change proposed results in no discernible improvement or deterioration to views or visual amenity.

6.2.4 In contrast to the above adverse effects, beneficial visual effects occur when the proposed development would enhance the quality of the receptor's view e.g. by creating a new focal point in a degraded landscape that includes a range of existing detractors.

## 6.3 Baseline Conditions: Site description

6.3.1 A Landscape Appraisal[25] was undertaken in March 2017 to support the development of the OBC and has been used to inform this chapter. The assessment progression for this chapter has involved the following key stages:

- Desk-based research to determine the scope of the study;
- Desk-based research to establish the landscape and visual baseline and identify potential receptors;
- A site visit undertaken in November 2020, to verify data collected in the OBC baseline studies, and to inform the Screening and Scoping report (JBA, December 2020);
- A site visit undertaken in June 2021 to verify current baseline conditions and collect viewpoint photography; and
- Assessment and reporting of potential effects.

6.3.2 The site covers a stretch of the Rhymney River from just north of the A4232 road bridge, down to the mouth of the river as it enters the Severn Estuary. The proposed works then extend north east adjacent to Lamby Way Landfill, and south west along the Severn Estuary to the DCWW WWTW.

6.3.3 The Rhymney River emerges from under a steel bridge that supports the Cardiff to Newport railway and flows for a short distance along a meandering river corridor with steep mud banks before passing under the A4232 road bridge. A large land drain to the east of the river also emerges from beneath the railway line, via a culvert and an old brick bridge, entering the river after a short distance along the left (east) bank. Smaller land drains also connect with the river along the left bank further downstream from an area of semi-wet grassland to the east. On the right (west) bank of the river, downstream from the railway bridge, there is a residential area of modern brick buildings, and a semi-wet grassland area with community allotments. Sections of the riverbanks are colonised by reeds and other riparian vegetation, dispersed amongst predominantly semi-wet grassland areas.

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[25] JBA Consulting, 2017. Cardiff Flood and Coastal Erosion Risk Management - Rover Way and Lamby Way Tip Outline Business Case, Landscape Appraisal, March 2017.

6.3.4 The river corridor begins to widen downstream of the A4232 bridge, and mudflats extend along the western side of the river on the inside of a large bend. On the left bank, an embankment colonised by emergent plant species separates the river from the area around Parc Tredelerch.

6.3.5 The river then flows under the B4239 'Lamby Way' highway, which forms part of the Wales Coast Path recreational trail. The riverbanks become steep along this stretch and are colonised by low-lying self-seeded vegetation around the higher areas. After a short distance, the river is intersected by a short section of channel remaining from the historic course of the river to the east. The river then continues in a more westerly direction, parallel to Lamby Way highway and the Wales Coast Path, separated by a thin stretch of bank that has been colonised by self-seeded native deciduous trees and scrub. To the east of the river there is a plateau colonised by scrub, and an area of deciduous trees planted on part of the site of the disused Lamby Way Landfill.

6.3.6 Further south-west, Lamby Way runs very close to the river as it meets the Rover Way/Lamby Way/A4232 ('Queen's Gate') roundabout. Along this stretch, sections of remnant rock armour are positioned along the right bank. The course of the river then continues in a more southerly direction. At this point, the Wales Coast Path has been temporarily diverted inland, while the old route of the Wales Coast Path continues as a footpath (PRoW) alongside the river, separated from the river by scrub and a few groups of self-seeded trees. A vegetated embankment sandwiched between the road and the path begins at this point and continues for approximately 800m. A low concrete retaining wall with a culvert is located between the path and the river as it begins to round a bend in an easterly direction. Rover Way highway runs parallel with the path at this point and both run in a south-easterly direction away from the course of the river.

6.3.7 The Rhymney River Motor Boat, Sail and Angling Club is situated on a thin strip of land created by the meandering river. Palisade fencing approximately two metres in height runs around the club's boundaries and down to the river's edge.

6.3.8 The course of the river then returns to run alongside the footpath for a short stretch. The pathway transitions from an informal grassy walkway to a concrete platform that has become partly overgrown by encroaching weeds and scrub.

6.3.9 The course of the river again meanders away from the path before connecting with the Severn Estuary to the south-east. These areas are covered in wet grassland and contain brackish waterbodies, and water flowing from these areas into the river has carved several small channels, eroding parts of the riverbanks.

6.3.10 At low-tide, large mudflats can be seen at the river mouth, attracting large numbers of migratory birds. The right bank of the Severn Estuary, north-east of the Rhymney River, features a mixture of mudflats, sand, stones, and remnant rock armour. On the landward side, the existing flood defence rock revetment is in a state of disrepair, and beyond this there is palisade security fencing approximately 2m in height around the boundary of Lamby Way Landfill. Further to the north-east, another section of the Wales Coast Path runs along the top of a raised embankment in parallel to the Severn Estuary.

6.3.11 To the south-west of the river mouth, the footpath continues to run alongside the estuary around an area of made ground, passing the Rover Way Traveller's site. Along this section there is much evidence of fly tipping and the coastline is eroding into the estuary. Further south-west, the erosion of the land becomes more extreme, creating vertical drops from the path down to the estuary. Along these parts, layers of rubble,

waste and geotextile layers have become exposed, making it unattractive for users of the footpath.

6.3.12 The path continues to follow the estuary, slightly inland, with hardy coastal vegetation to both sides. A motocross course comprising of a network of tracks is located on a raised area slightly further inland on the site of a disused landfill ('Frag Tip'). As the path emerges from the vegetated section, it continues to run alongside the estuary. Along this stretch, severe erosion of the coastline continues, and the foreshore is covered with concrete and brick from gabion baskets that have corroded and collapsed. On the landward side, the footpath passes a variety of industrial areas, including a large DCWW wastewater treatment plant and an active landfill. In some parts, the path passes very close to palisade fencing on the landward side, and there are sheer drops down to the rubble along the edge of the estuary.

6.3.13 The land curves to the west to an inlet where there is a drain that connects into the estuary via a large culvert. At this point, the footpath leaves the estuary edge and continues along Rover Way and Ocean Way towards Atlantic Wharf to the north-west. Beyond the drain and study area, further south, there appears to be less erosion and the topography becomes less steep. Concrete and brick from the heavily eroded gabion baskets continue around the estuary edge, and there is an industrial estate located slightly inland, separated from the foreshore by a band of scrub and deciduous trees.

## 6.4 Baseline Conditions: Landscape

### National Landscape Character Area (NLCA)

6.4.1 Wales has been divided into 48 National Landscape Character Areas (NLCA), each of which have descriptive profiles that make reference to their regionally distinct natural, cultural and perceptual characteristics.

6.4.2 Much of the site lies on the edge of NLCA 35, Cardiff, Barry and Newport. The relevant key characteristics of the area are as follows:

- Busy, heavily urbanised areas – containing Cardiff, and other large settlements including Penarth and Barry to the south to the west and the city of Newport and new town of Cwmbran to the east.
- Cardiff – capital city, largest urban area and principle administrative centre for Wales. The Romans established a settlement at Cardiff, with remains visible in Cardiff Castle. Mid-19th century growth as the most important port in the world for coal export. Cardiff Bay has since regenerated as a secondary focus in the city. The urban form of Cardiff expands across much of the surrounding landscape.
- Urban fringe/peri-urban areas – an example being the land between Penarth and Barry, which contains linear settlement linked by rural roads but has an urban fringe character in parts.
- Lowland river corridors – rivers Taff and Ely drain into Cardiff Bay and the tidal Rhymney River runs through east Cardiff; the tidal River Usk forms the focus of Newport with the River Ebbw meandering to the south east.
- Part of the site lies on the far western edge of NLCA 34, Gwent Levels. The relevant key characteristics of the area are as follows:
- Alluvium – former marsh and inter-tidal areas from the Severn Estuary. Triassic mudstones are beneath.
- Flood embankment to the sea – the land has been successively reclaimed from the sea and coastal marshes and is protected from the tides by a sea wall.

6.4.3 The site is also just to the west of The Gwent Levels, a Registered Landscape of

Outstanding and of Special Interest in Wales. This has been designated due to its extraordinarily diverse environmental and archaeological potential.

### Local Landscape Character: LANDMAP

6.4.4 LANDMAP (Landscape Assessment and Decision-Making Process) is a landscape assessment process developed by the Countryside Council for Wales (now Natural Resources Wales) to provide a system to cover the whole of Wales. The site is included within the following LANDMAP aspect areas, set out according to the particular LANDMAP data sets in which they appear:

6.4.5 Visual and Sensory:

- Rhymney valley floor urban fringe, River Rhymney, Lamby Way Park, Severn Estuary, Cardiff Flats, Cardiff East, Lamby Way Tip.

Historic Landscape:

- Pengam Moor, Rumney Intertidal Zone, Cardiff Flats Reclaimed Land, Southwest Wentlooge Level, Tremorfa, Cardiff Flats, and River Rhymney Corridor.

Cultural Landscape:

- Lamby Way Tip, Lamby Way Park, Severn Estuary, Cardiff Flats, Cardiff East, Rhymney valley floor urban fringe, Wentlooge Levels south west and River Rhymney.

Landscape Habitat:

- Lamby Lake & surrounds, Rhymney Estuary, Lamby Tip, Rhymney Mudflats, Cardiff Docks and Atlantic Wharf, Pengam Green and Tremorfa Park, Maindy to Splott, Wentlooge Levels (S. of Rhymney) and West of Rhymney Estuary.

6.4.6 Geology:

- Cardiff Flats, Rhymney river, Newton, N Pengam, Cathays – Roath, Docks East and Pengam Moors

6.4.7 The landscape character and visual information within these aspect data sets has been used to evaluate the particular characteristics of the site, in order to produce a bespoke assessment of the likely effects on the study area which may be brought about by the proposed development. See Appendix E for the Figures showing the extent of the LANDMAP aspect areas, and Appendix F for a summary of the LANDMAP aspect attribute tables.

### Marine Character Area

6.4.8 NRW were commissioned on behalf of Welsh Government to identify the character of Wales' seascapes at a broad scale. The inshore waters around Wales have been divided into 29 MCAs.

6.4.9 The site is part of Marine Character Area 29 Severn Estuary (Wales). There are a number of key characteristics that are relevant to the site.

- Expansive funnel-shaped Severn Estuary, sitting at the mouth of four major rivers (the Severn, Wye, Usk and Avon).
- The immense tidal range of the estuary is second only to the Bay of Fundy in Canada. The status of the tide has a significant bearing on perceived character.
- Soft Triassic and Jurassic rocks exposed along the shore, creating a wide rocky intertidal area. Elsewhere the shore is defined by extensive tidal flats

- Mud, sand and gravel sediments deposited in the Holocene period producing a varied seabed of flats and bars, with associated shallow waters and numerous shoals presenting hazards to navigation.
- Estuary important for the interpretation of coastline dynamics and land-forms, and also past changes in sea level, sediment supply, climate and river flow.
- Strong tidal streams and turbidity producing biological communities characteristic of the extreme physical conditions of liquid mud and tide-swept sand and rock.
- Tidal flats, saltmarshes and the extensive wet grasslands are of international importance for wintering waterfowl and migratory birds.
- Some of the richest and most diverse populations of non-exploited fish in the UK – Sea Lamprey and Twaite Shad populations are considered to be larger than in any other estuary.
- Flat coastline backed by the Wales Coast Path, affording long views into the Bristol Channel. Cars travelling along the M4 via the Severn Bridge also overlook the area.
- Views to major commercial, port and industrial development at Cardiff and Avonmouth, as well as the two road bridges, contrasting with the open, empty vistas characterising the Gwent Levels
- Seascape's open character affording strong intervisibility with the Somerset coastline, including Portishead, Clevedon and Weston-Super-Mare. The higher hill summits of the Quantock Hills Area of Outstanding Natural Beauty (AONB) and Exmoor National Park form a distinctive upland backdrop.
- Estuary's classic funnel shape and south-west orientation make it susceptible to extreme weather conditions (including storm surges) sweeping in from the east Atlantic.

The characteristics described above will form part of the bespoke assessment of the character of the study area and the likely effects which will arise due to the proposed development.

### Landscape designations

6.4.10 The study area is not located within any National Parks or Areas of Outstanding Natural Beauty (AONB).

### Cultural heritage designations

6.4.11 Impacts on the views and setting of designated cultural heritage assets including Listed Buildings, Scheduled Monuments, and Conservation Areas are covered within the chapter on Heritage within this report. This chapter is not an assessment of effects on designated or non-designated heritage assets. It also does not include an assessment of the significance of these effects. However, it is useful to consider these designations as they may inform landscape and visual sensitivity. The site is not within or adjacent to any Conservation Areas, nor are there Listed Buildings located within or adjacent. An assessment of the Gwent Levels Historic Landscape is included in the Heritage chapter.

6.4.12 The nearest Conservation Areas are Roath Mill Gardens, Roath Park, and Oakfield Street, and all are located between 1.0 and 2.0km to the west of the site. All of the Conservation Areas contain Listed Buildings of Grade I and II. There is no direct view of the site from any of the Conservation Areas. There are also no Historic Parks and Gardens within or adjacent to the site.

### Landscape character areas from site observations

6.4.13 The study area is a predominantly flat landscape with a few small areas of higher ground that have been created by landfill sites in the area. Views are available of

industrial areas to the south and residential areas to the west, with the A4232 flyover and B4239 Lamby Way bridge are visually dominant features in the north of the study area. Further to the southeast around the Rhymney River mouth and the Severn Estuary, the landscape is very open with expansive vistas looking out across the estuary.

6.4.14 The study area is located within the semi-natural/amenity greenspace comprising Pengam Moors and Parc Tredelerch, community allotments, a landfill reclamation site, a motocross course, woodland, scrubland, lakes, and the Rhymney River. The Wales Coast Path, a long-distance recreational route, runs alongside the Rhymney River and the Severn Estuary. The banks of the River Rhymney and River Severn feature a mixture of embankments, mud flats, sand, stone, rock armour and old flood defence walls that are in a state of disrepair. Along sections of the estuary foreshore fly tipping is very evident, while erosion of the estuary banks has created vertical drops, exposed layers of rubble, waste and geotextiles, making it unattractive for users of the Wales Coast Path.

6.4.15 From the site observations, informed by all desk-based assessment work, the study area was found to have four distinct landscape character areas:

- River – the river Rhymney corridor, with semi-natural and amenity greenspace on either side.
- Coastal - the zone along the banks of the River Severn.
- Urban – the area on the edge of Cardiff which consists of a mix of residential, industrial, and retail development.
- Lamby Way Landfill – the area beyond the banks of the river to the east covered by the landfill and the emerging construction of the solar farm.

The above surveyed landscape character areas are shown on Figure 6-1.

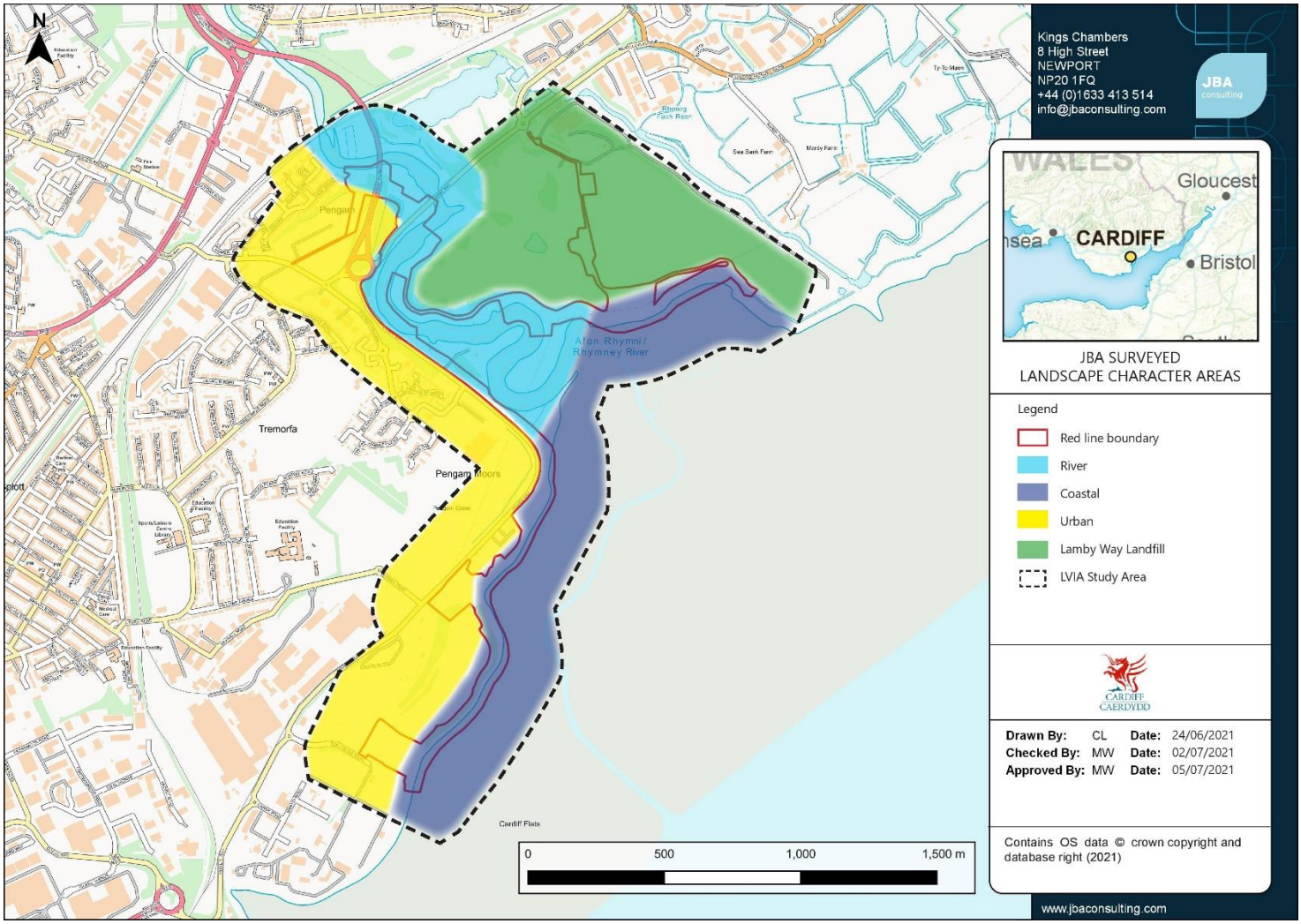


**Figure 6-1: Surveyed landscape character areas**

### Scope

6.4.16 The Screening and Scoping report (JBA, December 2020) proposed landscape features and character areas that will be assessed within this chapter. This has since been revised slightly to reflect the extent of the works.

6.4.17 Other landscape aspects that were scoped out at that stage are listed within the Screening and Scoping report, with justifications provided as to why they will not be assessed.

#### *Construction phase*

6.4.18 It is recognised that the construction phase is temporary, and any disruption will have a limited timescale. On this basis, it is concluded that the following may be affected during construction:

- Landscape features: The Rhymney River banks, the foreshore of the estuary, and trees immediately adjacent to the works.

- Landscape character: any of the landscape character areas within the study area which contain the river corridor, the estuary foreshore, and the residential areas.

***Operational phase***

- Landscape features: vegetation along the line of the works and immediately adjacent.
- Landscape character: any of the landscape character areas within the study area which contain the river corridor, and the estuary foreshore.

## 6.5 Baseline Conditions: Visual

### Visual environment

6.5.1 A general overview of the visual environment of the site and study area has been provided in the section above dealing with baseline conditions and the site description. Following the methodology, this will form the basis for the assessment of the likely effects for visual receptors which may be brought about by the proposed development.

### Scope

6.5.2 The Screening and Scoping report (JBA, December 2020) proposed visual receptors that will be assessed within this chapter. This has since been revised slightly to reflect the extent of the works. Other visual receptors that were scoped out at that stage are listed within the Screening and Scoping report, with justifications provided as to why they will not be assessed.

### Visual receptors

6.5.3 The likely effects for each receptor group described below are referenced to viewpoints which are set out in Appendix G. See Figure 6-2 for the Viewpoint locations.

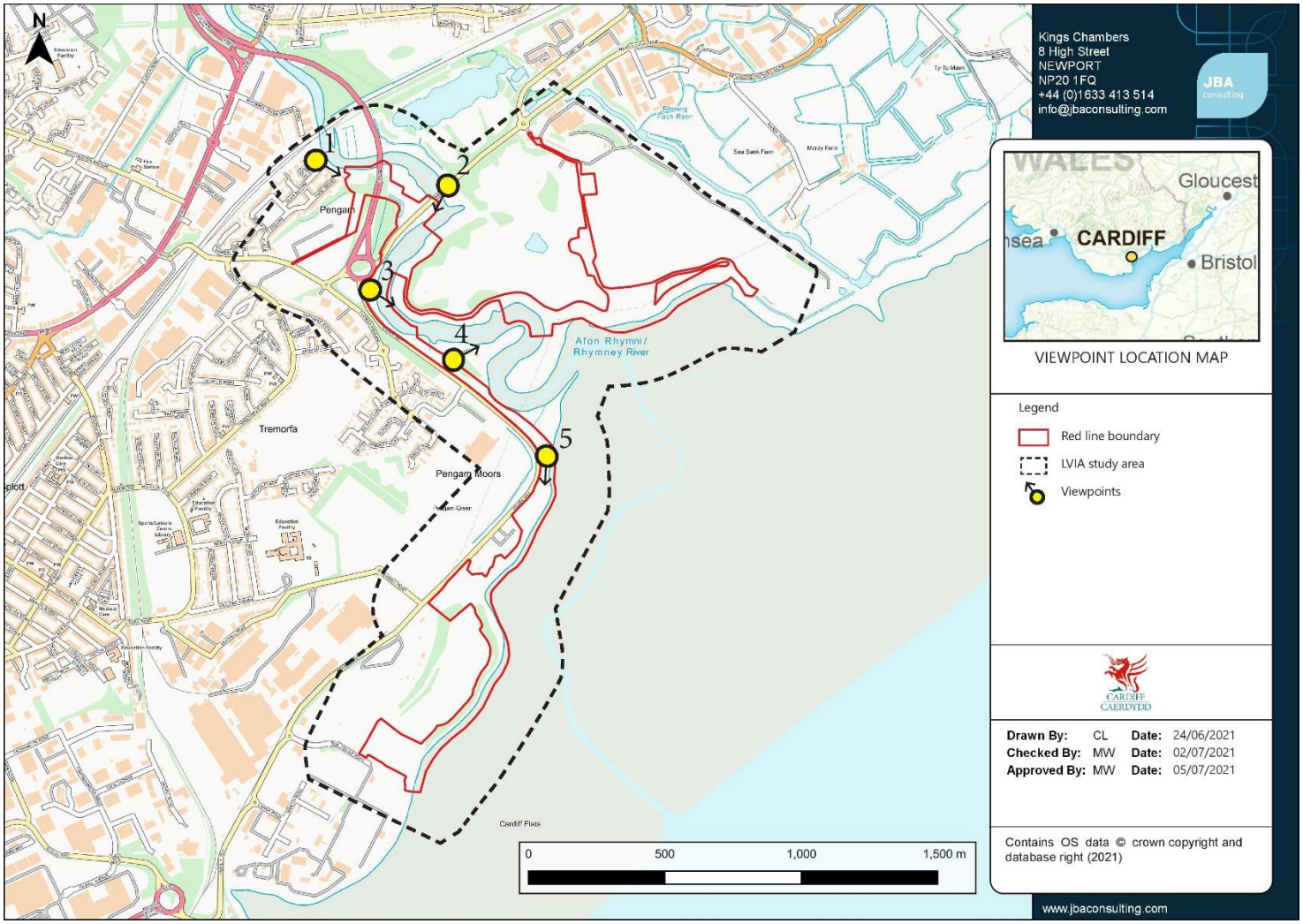


**Figure 6-2: Landscape viewpoint locations**

### Residents in the north of the study area (Viewpoint 1)

6.5.4 Residents are usually regarded as the most sensitive of visual receptors (GLVIA3). These receptors live on Page Drive, Cwrt Coles, and roads nearby, to the west of the river, close to the railway bridge at the northern end of the study area. The dwellings are a mix of 2,3 and 4 storey buildings consisting of both detached and semi-detached homes and flats. The garden boundaries between the properties and the area on the west bank of the river consist mainly of close-boarded fencing above head height. There are likely to be some views of the proposed embankment works between the housing and the A4232 from first floor windows and above. It is unlikely that the rest of the scheme will be visible.

### Residents of the Traveller site on Rover Way (Viewpoint 5)

6.5.5 The Traveller site sits to the south of the Tesco supermarket on Rover Way, and is adjacent to the works along the coast. The dwellings are single storey and the boundary of the site is in close proximity to the line of the Wales Coast Path (WCP) Public Right of Way (PRoW). There are some views from the site for some receptors within the Traveller's site of the site boundary and the vegetation along the top of the

existing foreshore.

### Receptors on the WCP and PRoW (Viewpoints 2, 3, and 4)

6.5.6 The WCP is an 882 mile long footpath that runs from Chepstow, Monmouthshire around the coast of Wales (including Anglesey), finishing at Chester, Cheshire. The WCP runs directly through the site, south west along the top of the Lamby Way Landfill and crosses the Rhymney River, where it is now temporarily diverted inland to the west. The route then runs parallel to Rover Way, continuing on along the River Severn estuary foreshore to the south.

6.5.7 As these receptors are participating in outdoor activities where the view is important, they are regarded as highly sensitive to any changes in their view. Receptors will have some clear views of the works within the river channel, particularly from the bridge on Lamby Way, and from the PRoW parallel to Rover Way where the two are in close proximity, and the band of vegetation is narrow, in the region close to the roundabout. The top of the proposed embankment will form the line of the PRoW (WCP) from a point to the north of the Rhymney River Motorboat, Sail & Angling Club access, down to a point approximately 100m to the west of the Traveller's site. At this point the PRoW (WCP) moves inland a little, then continues parallel to the coast through the rest of the study area.

### Receptors using Rhymney River Motorboat Sail & Angling Club and the river for recreation (Viewpoint 4)

6.5.8 Rhymney River Motorboat, Sail & Angling Club is located on the west bank of the Rhymney River. The club is active, and there are numerous boats on the small peninsula formed by the meandering of the river, and within the river channel. There are also other recreational users of the river in this area including anglers and canoeists.

6.5.9 These highly sensitive receptors have some clear views of the river, the riverbanks, and the vegetation on the tops of the banks and in the margins around. Those that venture out towards and into the River Severn will also have some clear views of the coastal areas either side of the mouth of the River Rhymney.

### Receptors on the railway (Viewpoint 1)

6.5.10 Those using the Cardiff to Newport railway, particularly those travelling from east to west, will have a clear view of the proposed embankment works to the north of the A4232 as they cross the River Rhymney bridge, albeit at a distance of approximately 250m. The view will be experienced at speed and in the context of the changing view as the train moves through the landscape. Receptors in this group are regarded as being moderately sensitive to changes in their view.

### Receptors using the road network (Viewpoint 2)

6.5.11 Lamby Way and Rover Way run alongside the Rhymney River, but views of the river and the riverbanks are mostly blocked by vegetation and embankments. Both the A4232 and Lamby Way cross the Rhymney River towards the north of the site and on these elevated sections have unobstructed views of the river on both sides. These views will be seen in the context of the busy roads, at speed, with the changing views of the landscape all around. As with those travelling on the railway, receptors in this group are regarded as being moderately sensitive to changes in their view (GLVIA3).

## 6.6 Landscape impact assessment

6.6.1 The landscape features which form an intrinsic part of the landscape character areas in which they occur are assessed below, along with those landscape character areas which are likely to be affected by the proposed development.

### Construction phase – Landscape features

***The Rhymney River banks***

6.6.2 During construction the banks of the river that are being worked upon will be greatly altered with the smooth mud surfaces seen at low tide being temporarily excavated prior to construction of the erosion control measures. It is judged that these features are not particularly susceptible to change, that they are not greatly valued, and that therefore they can be said to be of low sensitivity to the changes which are likely to arise from the proposed development.

6.6.3 In the context of the River Landscape Character area in which the banks are found, the extent which will be affected by the works is relatively small in scale, and the effects will last a relatively short period, being largely reinstated following construction. The magnitude of change will therefore be low, and the corresponding scale of effect will be slight adverse.

***The foreshore of the estuary***

6.6.4 The two areas either side of the mouth of the river will be excavated prior to the construction of the coastal erosion measures which will considerably alter this landscape feature. Currently both the foreshore to the north of the river mouth, and that to the south are a mix of natural and man-made materials. During the construction period the effect on the foreshore will be mixed, with the movements of construction machinery, and some unsightly excavated areas. However, as the excavations continue, the remnant rock armour, rock revetment, rubble, waste, and geotextile layers will be removed and replaced with a more uniform treatment comprising of new rock armour and graded embankments.

6.6.5 This landscape feature is of low sensitivity, whilst the extent of the magnitude of the change within the Coastal landscape character area will be low (considering the overall change throughout the construction period). Consequently, with the replacement of the somewhat unsightly mix of materials with a more unified appearance, there will be a slight adverse effect brought about by the proposed works.

***Trees***

6.6.6 The small area of existing trees next to the Queen's Gate roundabout sits within the River landscape character area. During construction this will be affected by the works with the possibility that some trees may need to be removed to provide a working area for machinery to enable the formation of the erosion protection measures. The trees, although not typical of the character area in which they occur, are a notable and attractive feature in the landscape and may be considered to be of medium sensitivity to the proposed changes.

6.6.7 The extent of the change within the landscape character area of the loss of some of these trees will be small in scale, and the magnitude is therefore low. Given the loss is likely to be minor, it is considered that the effect will be **slight-moderate adverse**.

### Construction phase – Landscape character

***River***

6.6.8 This area will experience notable disruption during this phase with active works within the various locations along the riverbanks and within the channel. However, the area also contains the flyover for the A4232, Lamby Way, and it borders the Queen's Gate roundabout and Rover Way. All of these roads are busy, and in this context the construction sites, access roads, and traffic management will be less obviously disruptive.

6.6.9 The character of the river berms, banks and channel will be more heavily impacted with the temporary access routes, construction sites, and construction machinery all contrasting with the existing character.

6.6.10 Taken as a whole, the area may be valued at a local level, but is considered to be of low sensitivity to the changes proposed. During construction the works can be considered of medium scale, and the magnitude of change to be medium also. The proposed change at this time would therefore constitute a ***slight-moderate adverse*** effect.

***Coastal***

6.6.11 The character of the coastal area is more tranquil than the others within the study area, with only the area bordering on Rover Way being busy with traffic. Much of the rest of the area is relatively quiet, with very little movement of men or machinery. This phase will bring notable disruption with construction areas, heavy machinery, and general human activity and movement changing the character on a temporary basis. It is considered that the area is of medium sensitivity to the changes proposed.

6.6.12 The works along the coast will be of medium extent and of medium scale, and it is judged that this will constitute a medium magnitude of change during this phase. The effect during construction will therefore be **moderate adverse**.

***Urban***

6.6.13 This is a busy area with a great deal of traffic on all the main roads. The additional movement of construction vehicles and the introduction of access routes are unlikely to have a noticeable effect on the overall character of the area.

6.6.14 It is judged that the area is of low sensitivity and the magnitude of change experienced will be low, and that the effect will be **slight adverse**.

***Lamby Way Landfill***

6.6.15 The landfill site will be used as the access route for construction traffic to the northern coastal section and the left hand river bank sections of the works. The site has been partially restored and vegetated, and is also now being developed as a solar farm. It is judged that the area is of low sensitivity and the magnitude of change experienced will be low, and that the effect will be **slight adverse**.

### Operational – Year 1 in winter – Landscape features

***The Rhymney River banks***

6.6.16 The in-channel erosion control measures are likely to blend well with the existing conditions, although it may take some time for mud to accumulate to hide, or partially

hide, the brushwood areas.

6.6.17 With the removal of the construction works, it is considered that the magnitude of the change at this time from the baseline conditions will be low, and therefore the scale of the effect will be **slight adverse**.

***The foreshore of the estuary***

6.6.18 This feature will now be considerably altered with the rock armour and graded embankments in place of the very mixed and somewhat unattractive foreshore which currently contains sand, stone, rock armour and old flood defence walls. The foreshore will now appear much more unified.

**6.6.19** It can be argued that the change from the baseline will be of low magnitude, and given that the sensitivity is medium to the changes proposed, the effect will be **slight-moderate beneficial.**

***Trees***

The bare earth areas will start to be naturally colonised although it is unlikely that this will be substantially evident at this stage. Being a feature of medium sensitivity, the low magnitude of the change will produce an effect that is **slight-moderate adverse**.

**Operational – Year 1 in winter – Landscape character**

***River***

6.6.20 The access routes, construction areas, and the embankments will either be naturally colonised or seeded. In either case, there may be some germination, but it is likely that these areas will largely be seen as bare earth at this time. The in-channel erosion control measures will be completed and overall it is likely that they will blend well with the existing conditions.

**6.6.21** With the removal of the construction works, it is considered that the magnitude of the change in this area will be low, and therefore the scale of the effect will be **slight adverse.**

***Coastal***

6.6.22 This area will now be considerably altered with the rock armour and embankments in place of the very mixed and somewhat unattractive nature of the foreshore. Although very much a man-made intervention, this is also a unifying change, which can be seen as positive for the character of the area. The removal of the construction works and the lack of construction activity on the site will allow the area to revert back to being relatively tranquil in comparison to the other landscape character areas within the study area.

6.6.23 It can be argued that the change from the baseline will be of low magnitude, and given that the sensitivity is medium to the changes proposed, the effect will be **slight-moderate beneficial**.

***Urban***

6.6.24 The mixed nature of this landscape character area means any evidence of the construction works which remain, such as bare earth access tracks, will not be particularly noticeable. The low sensitivity to change and the low magnitude of change at this time will equate to a **slight adverse effect**.

***Lamby Way Landfill***

6.6.25 The mixed nature of this character area with partially re-landscaped landfill areas and the emerging solar farm with access tracks make it of low sensitivity. At this time it is anticipated that any evidence of construction works will have a low magnitude of change, and that consequently there will be a **slight adverse effect**.

### Operational – Year 15 in winter – Landscape features

***The Rhymney River banks***

6.6.26 The in-channel erosion measures will be well-covered with mud and other sediments and will blend well with the natural riverbanks on either side. Within the River character area in which these are situated it is considered that the magnitude of change will be negligible by this time, and that therefore the effect for this feature will be negligible.

***The foreshore of the estuary***

6.6.27 The foreshore defences will have had time to weather slightly and some natural accretion of sediments will have occurred around the margins, bedding the feature in to the landscape. The graded banks above will have naturally colonised, and it is considered that the unifying nature of the works when compared to the baseline will have a medium magnitude of change, and that the effect overall will be Moderate beneficial.

***Trees***

6.6.28 The areas of bare earth around the trees will have naturally recolonised and the area will be well-vegetated. The character is likely to be similar to the baseline conditions, albeit with vegetation of lower stature than the existing trees. It is anticipated that this low magnitude of change will therefore result in a **slight-moderate** adverse effect.

### Operational – Year 15 in winter – Landscape character

***River***

6.6.29 The areas that were disturbed during construction will have had ample time to either re-colonise naturally, or for the seeded areas to grow and thrive. All the in-channel works will have had time to be covered with river sediments and to blend in with the existing character of the area. The new embankments will also be well-vegetated and will appear as an extension to the existing river defences.

6.6.30 In comparison to the baseline, it is considered that the magnitude of change will be negligible, and that therefore the effect will be **negligible**.

***Coastal***

6.6.31 It is likely that the erosion control measures will have naturally weathered a little and will be more a part of the landscape as material is washed in and around the rock armour. In addition, the embankments will have had time to naturally re-vegetate and settle within the landscape. The unifying effect of the rock armour will mean that the overall change compared to the baseline will be moderate beneficial.

***Urban***

6.6.32 By this point in time it is considered that there will be little or no evidence of the

construction works within this character area. It is judged that the effect will be **negligible** compared to the baseline conditions.

***Lamby Way Landfill***

6.6.33 Any evidence of construction works by this time are likely to be very minor, if noticeable at all. It is considered that the overall effect across this landscape character area will be **negligible**.

## 6.7 Visual impact assessment

6.7.1 The likely effects from the proposed development are now assessed for the visual receptor groups.

### Construction phase

6.7.2 As noted in the methodology, for the purposes of this assessment the duration of effects during this phase is likely to be mainly short-term in most areas for most receptors. The following assessment effects are judged on that basis, except where stated otherwise.

***Residents in the north of the study area***

6.7.3 The views for the receptors in this area of the construction works will be largely limited to first floor windows and above, as most gardens have close boarded fencing at above head height. These views will be limited to those whose houses are arranged around the southern and eastern sides of the development, and receptors living in flats on the second floor and above. The only part of the proposed development that is likely to be visible is that which is between the A4232 embankment and the housing estate. Along the eastern side of the housing development most windows are orientated to the northeast, so any view of the construction site will be oblique. Those houses on the southwestern edge of the housing development, facing on to the allotments, will have much clearer views of the embankment works, although this will diminish the further west you go. In the southwestern corner of the housing development the nearest property boundary will be adjacent to the construction site, while the flats close to the railway line in the north are up to approximately 160m away, and the furthest receptors to the west that might be affected are approximately 200m away.

6.7.4 Overall, for most receptors in this group, the scale of change will be medium, over a small extent of the view from upper storey windows. Taking in to account all views for residents in this area, including those from ground floor windows and gardens, the visual magnitude of change is likely to be low. With reference to the matrix for the Scale of Effects (Table 6-1) it is concluded that these receptors are likely to experience an overall **moderate adverse** effect, being a noticeable deterioration in their existing views during this phase.

***Residents of the Traveller site on Rover Way***

6.7.5 The construction area will be immediately adjacent to the property boundaries on the southeastern side of the Traveller site. There will be some clear views for these receptors of the construction site and traffic during this phase, with partial views for receptors in the rest of the Traveller site. Views will be partially obscured by the fencing surrounding the site, and any existing vegetation which can be retained. The vast majority of the receptors on the site are living in single storey accommodation, static caravans and similar, which will also limit views of the works.

6.7.6 Given the limited view to the southeast for most receptors it is considered that the magnitude of change for all receptors in the site is likely to be low, and that the effect will be **moderate adverse**.

***Receptors on the WCP and PRoW***

6.7.7 For receptors using the WCP and the PRoW there will be considerable disruption during the construction period with a temporary diversion inland around the 'Queen's Gate' roundabout working area. In addition, there will be clear views of much of the works, along with the movement of the works traffic. Given most receptors will be using the path for recreation where the views are important, this will have an adverse impact along much of the route within the study area.

6.7.8 There will be a major change across a wide expanse of the view in many areas along the WCP and PRoW. In areas with the greatest disruption it is likely that the magnitude of the change will be high, with other receptors in areas less affected by the proposed development experiencing a medium magnitude of change. As these receptors are likely to be highly sensitive to change, the effects are also likely to be **moderate-substantial adverse**.

***Receptors using Rhymney River Motorboat Sail & Angling Club and the river for recreation***

6.7.9 The works within the river channel will be clearly visible at close quarters for these receptors, whilst the works to the coastal defences will also be clearly visible, but at greater distance with the backdrop of the Lamby Way tip to the north, and the Traveller's site, motocross course, and FRAG tip to the south. As these are recreational receptors, the view is important and they are likely to be sensitive to any adverse changes. This will be in the context of navigating the river/estuary with the movement changing the view all the time, and the necessity of needing to concentrate on steering a clear path through the water.

6.7.10 In places there will be a large-scale change to the view during construction, although this will be limited in extent to a relatively small extent of the view, except when receptors are in close proximity to the works within the river channel. It is anticipated that the overall magnitude will be medium with a noticeable change in views, and that therefore the effect will be **moderate adverse**.

***Receptors on the railway***

6.7.11 The closest part of the works will be the construction area for the embankment to the west of the A4232 which will be approximately 190m away at the closest point for those on the railway travelling over the river bridge. It is likely the works will only be visible between the bridge and the point where the railway goes beneath the A4232 flyover, and that only the embankment works in this area will be visible as the rest of the proposed development will be obscured by the A4232 flyover embankment. The change visible will be medium in scale and occurring across a small extent of the view for these receptors, and will therefore be of a low magnitude.

6.7.12 On this basis it is considered that the effect for train passengers, travelling at speed with a changing view, will be **slight-moderate adverse**.

***Receptors using the road network***

6.7.13 There will be some considerable disruption at times for road users, particularly around the 'Queen's Gate' roundabout where some roads will be subject to lane restrictions

and traffic lights. There will also be noticeable temporary changes around the access points into the works, with works traffic entering and exiting site. These disruptions are occurring along very busy roads and so the net change in views for road users needs to be judged in this context. The visual focus for most using the road network will be on the road and on other road users.

6.7.14 Receptors are likely to be of low sensitivity to change, and will be experiencing a low magnitude of change given the existing context in and around the road network. As a result, the effect is considered to be **slight adverse**.

### Operational – Year 1 in winter

6.7.15 Once the works are complete and site hoardings, temporary huts, fencing and other associated paraphernalia are removed, the coastal rock armour, newly-formed embankments, and in-channel protection measures will all be visible. Whilst the coastal rock armour and the in-channel protection measures will be largely visually complete, the newly formed embankments, working areas, and access tracks will still be seen largely as bare earth. Seed germination or natural colonisation in these areas may be visible, but it is unlikely that a green sward or vegetated covering will have established. Any deciduous vegetation will have lost their leaves and views within the study area will be more open than at other times of the year.

***Residents in the north of the study area***

6.7.16 Some residents here will have views from upper storey windows of the newly formed embankments which will be starting to re-vegetate, as will the access route and working areas. The new embankment will be seen in the context of the existing embankment for the A4232, and so will not be out of place as a feature in the landscape.

6.7.17 It is likely that the scale of the change will be small, occurring over a small part of the view for most receptors, and therefore will be of low magnitude. This equates to a moderate adverse effect for this group of highly sensitive receptors.

***Residents of the Traveller site on Rover Way***

6.7.18 It is unlikely that the proposed embankment and rock armour will be visible for the majority of receptors within the Traveller's site due to the fencing around the site perimeter. However, the raising of the embankment level may allow receptors to see those using the WCP/PRoW, and vice versa. This is likely to be perceived as a noticeable change, given that these walkers were less visible, or not visible at all, prior to the works being carried out. As a consequence, it is considered that the magnitude of change will be low, and the effect will be **moderate adverse**.

***Receptors on the WCP and PRoW***

6.7.19 The sections of the footpaths that were diverted or being rebuilt will now be reopened and receptors will be able to walk along the full route of the WCP and PRoW once again. The banks of the embankments, access and construction working areas are likely to be still quite bare as the seeding and planting starts to establish. However, the route alongside Rover Way and alongside the coast will now be formed from a much more substantial embankment. In particular, the unsightly areas of the coastline will be much improved, and the new route will be slightly elevated with a small improvement in the scale of the views which can be enjoyed.

6.7.20 On balance, the magnitude of the change from the baseline conditions is likely to be

low, and so the scale of the effect will remain **moderate adverse**.

***Receptors using Rhymney River Motorboat Sail & Angling Club and the river for recreation***

6.7.21 Views for those using the north-eastern end of the club compound, and those on the river, will be of the newly formed river channel defences which will be a noticeable change from the baseline. The covering of mud, soil, and the brushwood higher up the banks will help to blend the new defences in to the existing landscape. The newly formed embankment and flood gate at the entrance to the club will also be a noticeable addition to the landscape, as will the rock armour along the coastline, albeit this will be seen at a greater distance.

6.7.22 On balance, with some of the improvements in the views of the coastal areas in particular, it is anticipated that the magnitude of change will be low, with a slight-moderate adverse effect.

***Receptors on the railway***

6.7.23 Once all construction work has ceased and all temporary measures (fencing etc) have been removed it is unlikely that the section of the works that will be visible to train passengers will be noticeable in their view, particularly whilst travelling at speed. It is judged that the change from the baseline, considering the full expanse of the view available for these receptors, will be negligible, and that therefore the effect will also be **negligible**.

***Receptors using the road network***

6.7.24 The main adverse changes for these receptors during construction, including all the traffic measures and construction traffic, will now be gone. Consequently, because of the nature of these receptors (travelling at speed, concentrating on the road and on other traffic) it is considered that the change from the baseline at this time will be negligible, and that therefore the effect will be **negligible**.

### Operational – Year 15 in winter

***Residents in the north of the study area***

6.7.25 Those residents that have views of the newly formed embankment and construction working area will now see that the areas have naturally re-colonised, embedding these defences within the landscape. In the context of the current baseline with the existing embankment for the A4232 it is anticipated that the change for the majority will be negligible, with views for most extending out over the allotments, river corridor, and on towards Parc Tredelerch. The scale of effect is therefore considered to be **negligible** for receptors in this area.

***Residents of the Traveller's site on Rover Way***

6.7.26 Receptors will continue to be able to see walkers on the WCP/PRoW, though this may have reduced slightly over time with some natural vegetation growth along the boundary between the site and the coast.

6.7.27 On balance it is considered that the magnitude of change will be low, with the embankment and rock armour not being visible, due to the perimeter fence around the site, for receptors in this area, and therefore the effect with be **moderate adverse**.

***Receptors on the WCP and PRoW***

6.7.28 By this point in time all seeding and natural recolonisation will have had time to establish. The new works to the river channel, the embankments, and the coastal defences will have had time to bed into the landscape. Many views for these receptors along the WCP/PRoW route will show no change from the baseline, with some improvement where the elevated embankment sections allow for greater visual access next to the river, and also with improvements to the visual conditions along the southern section of the new coastal defences.

6.7.29 It is considered that the overall magnitude will be negligible, with a corresponding negligible visual effect.

***Receptors using Rhymney River Motorboat Sail & Angling Club and the river for recreation***

6.7.30 The upper banks of the river channel will have recolonised with vegetation by this time. In addition, the stretches of brushwood will have encouraged natural deposition of mud, helping to bed the defences into the landscape. The seeding and any natural colonisation along the embankment which follows the line of the WCP/PRoW will also have had time to establish, helping to blend this feature in to the landscape. Views of the coastal defences will be softened by the build-up of some sediments on the margins, and the graded embankments in these areas will have been recolonised.

6.7.31 It is considered that the overall effect will be of low magnitude, and that the effect will be **slight-moderate adverse**.

***Receptors on the railway***

6.7.32 The embankment north of the A4232, the only part of the works visible for these receptors, will have had time to naturally re-colonise by this time. The bare earth will have been replaced with vegetated slopes, and the embankment will be seen in the context of the road embankment to the south. It is considered that the change will be negligible, and that therefore the effect will be negligible also.

***Receptors using the road network***

6.7.33 By this point in time the in-channel erosion measures which are visible from the Lamby Way bridge will be largely covered with mud and sediments from the river. The other visible works areas will have re-colonised naturally or, where there are embankment areas next to Rover Way that will be reseeded, will have a good sward and will blend with their surroundings. Given the nature of these receptors, it is judged that the magnitude of change from the baseline will be negligible, and that therefore the effect will be **negligible**.

## 6.8 Mitigation

6.8.1 The following section describes the measures that will be taken to help to reduce adverse landscape and visual effects (see Appendix H for the landscape mitigation plan). Though the measures described may reduce these effects, it may be that this is not sufficient to reduce their significance, or to eliminate them altogether.

### Construction phase

6.8.2 The mitigation options are likely to be limited during this period and will rely on good construction practices to limit the disturbance to landscape and visual receptors. Early seeding/planting may be possible in certain areas to help to minimise any adverse effects during this phase.

***Operational phase***

6.8.3 The following measures have been taken in two areas to mitigate for specific adverse effects, as described below.

***The Queen's Gate Roundabout***

6.8.4 Trees and vegetation lost in this area during the works will be replaced with new planting that is designed to integrate with the species that remain, to provide visual interest, and to provide some screening of the busy road network for those using the WCP/PRoW. The planting will make a positive contribution to the overall landscape character of the area.

***The Traveller Site***

6.8.5 There will be planting to provide a natural screen between the Traveller site and the WCP/PRoW. By Year 15 in winter the new planting will be providing an improvement to the baseline with visual interest, as well as acting as a visual screen, and adding a positive landscape feature to the landscape character in this area.

6.8.6 In addition, a privacy fence will be installed between the Traveller site and the WCP/PRoW so that walkers on the footpath cannot be seen by the residents, and vice versa.

## 6.9 Residual effects

6.9.1 The following adverse residual effects have been reduced following the application of the mitigation set out above.

**Operational Year 15 in winter – Landscape features - Trees**

6.9.2 The new planting next to the roundabout will be small in stature in the winter of Year 1, and will be within bare earth areas. It is not anticipated that this will reduce the slight-moderate adverse effect at this time. However, by Year 15 in winter the trees will have had time to reach a size which will be in keeping with the existing trees, although they will probably not yet have as broad a canopy or be as tall. On balance, it is considered that the effect for this landscape feature will be negligible, taking in to account the mitigation planting.

**Operational Years 1 and 15 in winter – Visual receptors - Residents of the Traveller's Site on Rover Way**

6.9.3 It is considered that the mitigation planting and fencing will reduce the adverse visual effects for the receptors at the Traveller's site, and that the residual effect will be negligible during the operational phase of the development.

6.9.4 For all other landscape and visual receptors, the effects set out in the assessment remain unaltered by the mitigation listed. All residual effects for all receptors are summarised below, along with an assessment as to whether this effect is considered to be significant.

**Table 6-2: Residual and significant effects**

| Aspect | Receptor | Phase | Residual Effect | Is the effect significant? |
|---|---|---|---|---|
| **Landscape Features** | Rhymney river banks | Construction | Slight adverse | No |
| | | Year 1 winter | Slight adverse | No |
| | | Year 15 winter | negligible | No |
| | The foreshore of the estuary | Construction | Slight adverse | No |
| | | Year 1 winter | Slight-moderate beneficial | No |
| | | Year 15 winter | Moderate beneficial | **Yes** |
| | Trees | Construction | Slight-moderate adverse | No |
| | | Year 1 winter | Slight-moderate adverse | No |
| | | Year 15 winter | negligible | No |
| **Landscape Character** | River | Construction | Slight-moderate adverse | No |
| | | Year 1 winter | Slight adverse | No |
| | | Year 15 winter | negligible | No |
| | Coastal | Construction | Moderate adverse | **Yes** |
| | | Year 1 winter | Slight-moderate beneficial | No |
| | | Year 15 winter | Moderate beneficial | **Yes** |
| | Urban | Construction | Slight adverse | No |
| | | Year 1 winter | Slight adverse | No |
| | | Year 15 winter | negligible | No |
| | Lamby Way Landfill | Construction | Slight adverse | No |
| | | Year 1 winter | Slight adverse | No |
| | | Year 15 winter | negligible | No |
| **Visual** | Residents in the north of the study area | Construction | Moderate adverse | **Yes** |
| | | Year 1 winter | Moderate adverse | No |
| | | Year 15 winter | negligible | No |
| | Residents of the Traveller's Site on Rover Way | Construction | Moderate adverse | **Yes** |
| | | Year 1 winter | negligible | No |
| | | Year 15 winter | negligible | No |
| | Receptors on the WCP and PRoW | Construction | Moderate-substantial adverse | **Yes** |
| | | Year 1 winter | Moderate adverse | No |
| | | Year 15 winter | negligible | No |
| | Receptors using Rhymney River Motorboat Sail & Angling Club / river | Construction | Moderate adverse | **Yes** |
| | | Year 1 winter | Slight-moderate adverse | No |
| | | Year 15 winter | Slight-moderate adverse | No |
| | Receptors on the railway | Construction | Slight-moderate adverse | No |
| | | Year 1 winter | negligible | No |
| | | Year 15 winter | negligible | No |
| | Receptors using the road network | Construction | Slight adverse | No |
| | | Year 1 winter | negligible | No |
| | | Year 15 winter | negligible | No |

# 7 Historic Environment

## 7.1 Introduction

7.1.1 This chapter sets out the heritage significance of the proposed scheme and assesses the impact that the proposed works would have on that significance. The assessment is in line with paragraph 6.1.9 of Planning Policy Wales 2018 which states:

*7.1.2 'Any decisions made through the planning system must fully consider the impact on the historic environment and on the significance and heritage values of individual historic assets and their contribution to the character of place.'*

## 7.2 Geology and Ground Conditions

7.2.1 Information has been collected from the British Geological Survey regarding geological conditions on the site (http://mapapps.bgs.ac.uk/geologyofbritain/home.html). The underlying geology of the site is mudstone from the Mercia Mudstone Group, which is a sedimentary bedrock that formed approximately 201 to 252 million years ago in the Triassic Period. The majority of the superficial deposits laying across the site include flat deposits of clay, silt and sand that formed approximately two million years ago during the Quaternary period. However, there is a small area of glaciofluvial sheet deposits of sand and gravel that formed during the Devension glacial peroiod located to the south end of the location 32 works.

## 7.3 Legislative and Planning Policy Context

7.3.1 The assessment aims to address the requirements of relevant legal frameworks and planning policy pertinent to the site and its proposed development. The following are considered to be relevant to this assessment:

- Planning Policy Wales, 2018;
- Technical Advice Note 24: The Historic Environment, 2017;
- The Well-being of Future Generations (Wales) Act 2015;
- The Historic Environment (Wales) Act 2016; and,
- Cardiff Council Local Development Plan.

### Planning Policy Wales (2018)

7.3.2 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes, Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales.

7.3.3 The main objective of PPW is to ensure that the planning system contributes towards the deliver of sustainable development and improves social, economic, environmental and cultural well-being in Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation.

7.3.4 Chapter 6.1 of PPW sets out the planning policy of the Welsh Government with regards to the historic environment. The national planning policy framework for the historic environment as set out in PPW is supplemented by Technical Advice Note 24: The Historic Environment and Cadw associated best practice guidance on the historic environment.

### Technical Advice Note 24: The Historic Environment (2017)

7.3.5 The purpose of Technical Advice Note (TAN) 24 is to provide guidance on how the planning system considers the historic environment during development plan preparation. TAN 24 provides specific guidance on how the following aspects of the historic environment should be considered:

- World Heritage Sites,
- Scheduled Monuments,
- Archaeological remains,
- Listed Buildings,
- Conservation areas,
- Historic parks and gardens,
- Historic landscapes, and
- Historic assets of special local interest.

7.3.6 The historic environment is defined as follows:

*7.3.7 "All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and deliberately planted or managed."*

7.3.8 A historic asset is defined as:

*7.3.9 "An identifiable component of the historic environment. It may consist or be a combination of an archaeological site, a historic building or area, historic park and garden or a parcel of historic landscape. Nationally important historic assets will normally be designated."*

### The Well-being of Future Generations (Wales) Act 2015

7.3.10 The Well-being of Future Generations (Wales) Act 2015 places duties on public bodies requiring them to act in accordance with the 'sustainable development principle'. The Act also establishes well-being goals which include achieving 'a Wales of vibrant culture and thriving Welsh language', described as 'a society that promotes and protects culture, heritage and the Welsh language. A properly protected, conserved and enhanced historic environment can improve the quality of life and well-being for everyone.

### The Historic Environment (Wales) Act 2016

7.3.11 The legislative framework for the historic environment in Wales was revised by The Historic Environment (Wales) Act 2016. The 2016 Act amended the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990. It extended the definition of Scheduled Monuments and enhanced their protection, as well as making changes to the process of Scheduled Monument consent. Changes were also made to the protection of Listed Buildings. The 2016 Act also provided for a statutory register of historic landscapes, a statutory list of place names, and imposed a statutory duty on Welsh Ministers to compile and maintain HERs.

### Cardiff Council Local Development Plan

7.3.12 On 28th January 2016 Cardiff Council adopted a Local Development Plan (LDP) for

Cardiff. The LDP will be used by the Council to guide and manage development, providing a basis by which planning applications will be determined and will supersede the existing adopted development plan framework for Cardiff. The Plan has one policy, EN9, relevant to the historic environment, which is reproduced below.

***EN9: Conservation of the Historic Environment***

7.3.13 Development relating to any of the heritage assets listed below (or their settings) will only be permitted where it can be demonstrated that it preserves or enhances that asset's architectural quality, historic and cultural significance, character, integrity and/or setting.

*i. Scheduled Monuments;*

*ii. Listed Buildings and their curtilage structures;*

*iii. Conservation Areas;*

*iv. Archaeologically Sensitive Areas;*

*v. Registered Historic Landscapes, Parks and Gardens; or*

*vi. Locally Listed Buildings of Merit and other historic features of interest that positively contribute to the distinctiveness of the city.*

## 7.4 Sources Consulted

7.4.1 In 2017, the Projects Department of the Glamorgan-Gwent Archaeological Trust (GGAT Projects)26 were commissioned to carry out an archaeological desk-based assessment on the then proposed Cardiff flood defences project area (provided in Appendix I). Since this assessment was undertaken the Cardiff flood defences project area has been revised and reduced in scope. As a result of the revised scheme boundary, in 2020 the Heritage Team within JBA Consulting adjusted the study area, reassessed and revised the baseline assessment.

7.4.2 A study area buffer of 100m around the site boundary has been considered to place the development site within its archaeological and historic context. The following data and information sources have been consulted in preparation of this assessment:

- Cadw for designated assets
- GGAT Historic Environment Record data
- Cartographic Sources
- Documentary Sources
- Results of ground investigation (GI) works

7.4.3 A site visit was completed on 8th February 2021 by Kristian Evans to assess the current site conditions, to assess the likely effects on the settings of nearby designated and non-designated assets, and to consider the potential for future investigations.

7.4.4 Pre-application consultations were undertaken with GGAT to discuss potential impacts and mitigation requirements of the scheme.

7.4.5 The assessment considered both the direct effects of the proposal on cultural heritage assets within the proposed site extent, and of indirect effects on assets located outside of the site boundaries. The baseline conditions were determined by means of desk-

[26] GGAT Projects (2017) Flood Defences, Afon Rhymney, Cardiff: Archaeological Desk-Based Assessment.

based studies and a site visit. The desk-based study collected information from the Regional HER, the National Monuments Record (NMR), and Scheduled Ancient Monument and Listed Building information. Aerial Photographs, Cartographic and documentary sources were also reviewed. The 2020 reappraisal was undertaken using online sources through Archwilio and Cof Cymru which identified that the content of the 2017 study for the new study area was still relevant and valid.

## 7.5 Baseline Conditions

7.5.1 This section presents a summary of the historical background for the area, based on the results from the desk-based studies. Data searches identified thirteen recorded assets within the study area and nine archaeological events. Details of these heritage assets and events can be seen in Appendix J and their locations are shown on Figure 7-2. Assets and events within the site boundary are highlighted in blue in the gazetteer in Appendix J. Assets recorded in the original HER are referred to by their Primary Record Number (PRN), while those recorded in the NMR are referred to by their National Primary Record Number (NPRN).

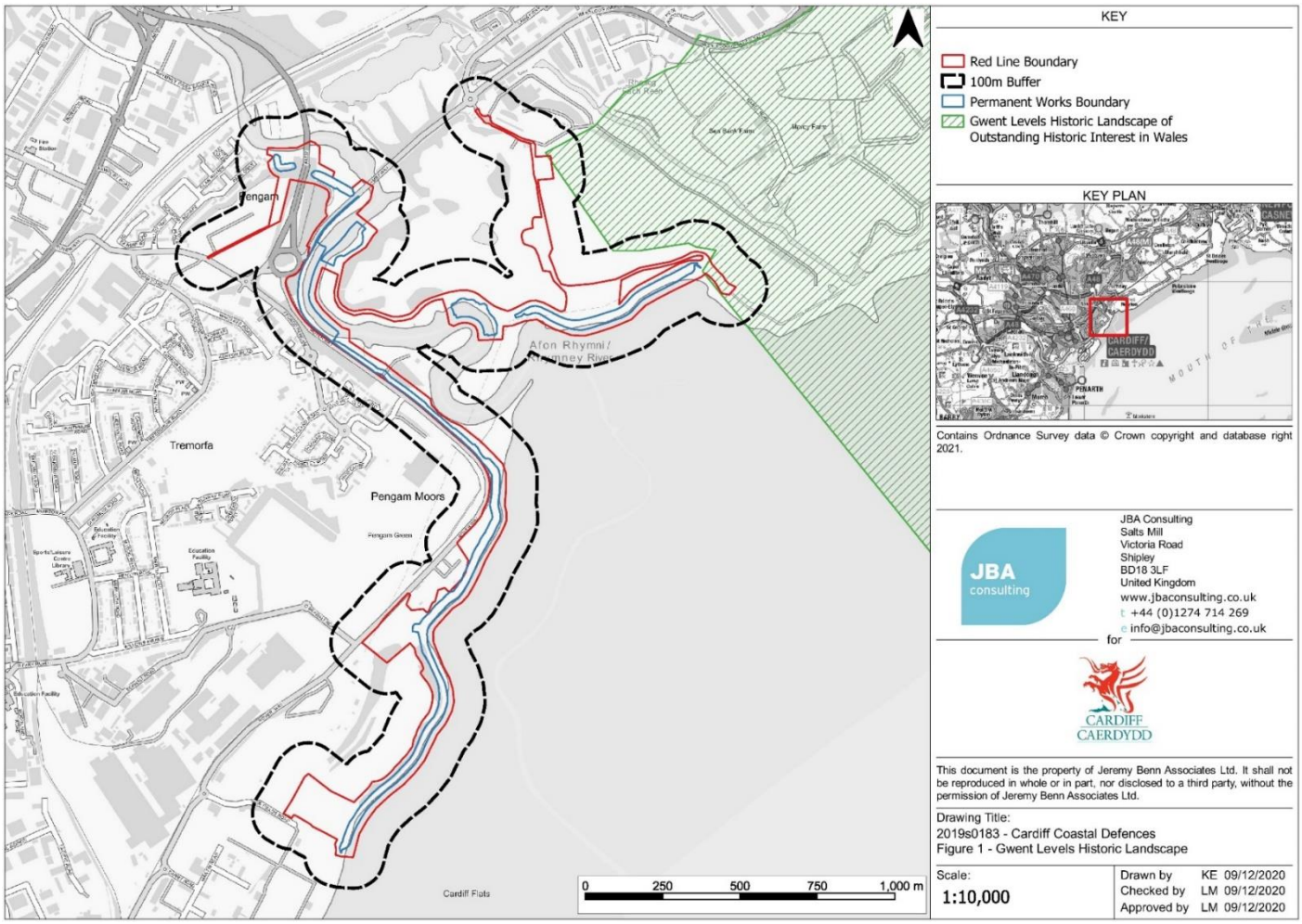


**Figure 7-1: Gwent Levels Historic Landscape**

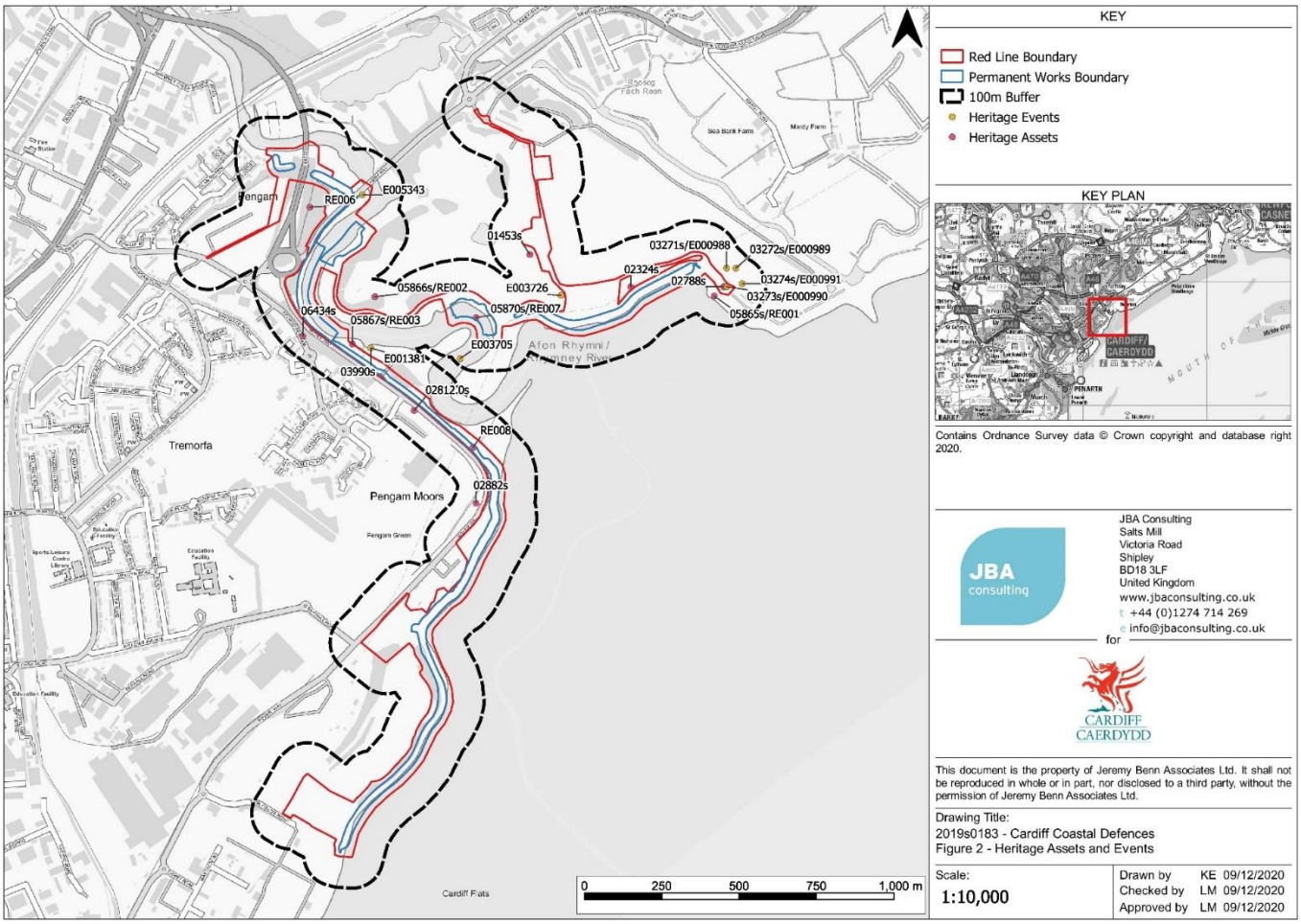


**Figure 7-2: Heritage assets and events**

### Designated heritage assets

7.5.2 There are no World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Protected Wreck Sites, Registered Parks and Gardens or Registered Battlefields within the study area.

7.5.3 Within the wider study area, the closest Listed Building to the site is the 'Rumney Pottery' building (13761), a Grade II listed house and pottery building located approximately 400m north-west of the site. The building is in an important position by the river, the traditional boundary between Glamorgan and Monmouthshire, with a quay marked on early maps indicating a trading site, which was reportedly used for

smuggling.

7.5.4 Three Conservation Areas; Roath Mill Gardens, Roath Park and Oakfield Street are all located between 1.3km-1.8km to the west of the site. All of the conservation areas contain Grade I and II Listed Buildings. Within the extent of the Roath Mill Gardens Conservation Area is the Grade II Waterloo Gardens and Roath Mill Gardens Registered Park and Garden.

7.5.5 Relict Seawall on Rhymney Great Wharf (GM474) is located c.800m to the east of the site extent and is a Scheduled Monument. The seawall is 500m in length standing between 1m to 2m high. Documentary evidence shows the sea defence was in place as early as 1591, and much of the surviving clay bank is thought to be original.

7.5.6 The Gwent Levels comprises three discrete and extensive areas of alluvial wetlands and intertidal mudflats situated on the north side of the Severn Estuary. They represent the most significant example in Wales of a man-made landscape, being entirely the work of man. The Gwent Levels have been recurrently inundated and reclaimed from the sea from the Roman period onwards. The site lies adjacent to the Rumney Character Area, which is a landscape typical of piecemeal medieval reclamation (GGAT) The Gwent levels have a past potential for extensive, well-preserved, buried, waterlogged, archaeological and palaeoenvironmental deposits surviving from earlier landscapes (GGAT).

### Non-designated heritage assets

#### *Prehistoric (up to 43 AD)*

7.5.7 The Palaeolithic period in Wales begins approximately 250,000BC, but occupation was sporadic due to multiple periods of glaciation which cause large sheets of ice to cover the land making it uninhabitable. Due to the destructive effects of these ice sheets surviving evidence relating to the Palaeolithic is often erratic. There are numerous cave sites in South Wales that provide evidence for Palaeolithic activity. Paviland Cave in Southeast Wales contained archaeological deposits dating to the upper palaeolithic period. The site is most famous for the burial of the 'Red Lady of Paviland', who was in fact a young adult male. The skeletal remains have been radio-carbon dated and shown to be 33,000 years old and were accompanied by a number of grave goods.

7.5.8 During cold glacial periods, such as the Devensian, the Severn Estuary would have been a normal dryland river valley flood plain, forming part of the territory of hunter-gatherer bands. During warmer interglacial periods sea levels would have been somewhat higher than today, with the estuary flanked by gravelly beaches. Evidence for Palaeolithic activity on the Gwent Levels comes from sites such as Sudbrook Point, where several Palaeolithic implements, including two Levallois flakes, two ovate handaxes, a fragment of a third handaxe, several crude cores and a waste flake (Rippon 1996, 14)27. There are no recorded heritage assets of Palaeolithic date within the study area.

7.5.9 During the Upper Palaeolithic Britain was only partially occupied depending on the climate, and these periods of occupation were often relatively fleeting. As climate improved at the end of the last glacial period, the Mesolithic period sees the start of continuous occupation of the British Isles (Conneller et al., 2016). There is evidence

[27] Rippon, S. J. (1996). The Gwent Levels: the evolution of a wetland landscape. https://doi.org/10.5284/1081793.

for Mesolithic activity in the wider Severn Estuary area. The earliest evidence for human activity comes from Goldcliff, located approx. 15km NW of site, where an occupation layer produced material including struck flint, chert, bone, antler, charcoal and pyroclasts (Parkhouse 1990, 11). At Uskmouth, footprints of Mesolithic date have been recorded within an estuarine clay that is overlain with peat deposits (Aldhouse-Green 1990, 5).

7.5.10 Towards the middle of the Mesolithic, c. 6000 BC, the rapid rise of sea levels slowed when it reached around 8m below the present sea level. Around this time the Severn Estuary and the Gwent Levels would have been dominated by a wet alder woodland, reed swamps and raised bogs (Rippon 1996, 19)26. Tree stumps have been discovered on the foreshore of the Rhymney Great Wharf and subsequently radiocarbon dated to between 6000 and 8000 years BP (Neal 2005, 12-15)28. The woodland results in the formation of peat deposits, known from borehole and deep excavations. Peat deposits around the Rumney Great Wharf are thinner than in other areas of the Severn Estuary, and they decrease as they approach the river Rhymney (Rippon 1996, 19)26.

7.5.11 The Neolithic period in Britain begins around 4200 BC, brought about by the arrival of new ideas, practices and behaviours to the British Isles (Cunliffe 2012, 133)29. The period is a transitionary one, and there would have been much overlap between old hunter gatherer practices and the new Neolithic way of life between 4200BC to 3800BC (Cunliffe 2012, 134)28. The earlier Neolithic is marked as the period when seasonal mobility was gradually overtaken by farming as the primary means for acquiring dietary subsistence, though it never ceased completely, as foraging and hunting continued to be important. Nevertheless, farming and the dependence on domesticated animals and plants would mark a clear departure from the prehistoric periods that had come before. During this period, megalithic tombs and large-scale timber, earthen and stone monuments such as henges, cursus monuments, cairns and stone circles appeared on the landscape for the first time. The Neolithic also sees the introduction of pottery and the production of new lithic techniques, most clearly seen in the production, use and exchange of polished stone tools.

7.5.12 Neolithic activity in the wider area is evidenced by a find of a Neolithic arrowhead found in upper Wentlooge formation ditch fill at Rumney Great Wharf, and numerous other findspots from around the Severn Estuary (Rippon 1996, 20)26. Human remains have also come out of Goldcliff and Uskmouth, where two human skulls dated to the Neolithic were discovered at each site. There are no recorded heritage assets of Neolithic date in the study area.

7.5.13 The Bronze Age in Wales, like the rest of Britain, sees the rapid introduction of bronze and gold smithing technology and the production of everyday tools, weapons, and ritual items with these materials. Mortuary ceremonies also change emphasis in this period, with a shift from the large communal complexes and inhumations of the Neolithic, to round barrow cemeteries and subsequently individual cremations, but monuments such as henges and stone circles continue to be built and improved upon during the Bronze Age. In coastal areas communities made extensive use of saltmarsh for seasonal animal husbandry, and the Severn Estuary has produced extensive evidence for temporary seasonal pastoralist settlements located on the wetland (Bell 2013)30. At Rumney Great Wharf, three later Bronze Age occupation sites have been discovered

[28] Neal M, Atherton S, Nurse M, Hambly A, and Parker S. (2005) Rumney and St Mellons: A History of Two Villages. Rumney and District Local History Society

[29] Cunliffe, B. (2013) Britain Begins. Oxford: Oxford University Press

[30] Bell, M. (2013). The Bronze Age in the Severn Estuary. York: Council for British Archaeology.

featuring fire-cracked pebbles, small charcoal fragments, animal bones and teeth, pottery fragments and potential post-holes (Allen 1995, 9-10)31. There is one record dated to the Bronze Age within the study area: a side-loped spearhead (02882s) that was found in an unstratified context on estuarine clay during a field survey (Green 1989, 187-199).

7.5.14 Into the Iron Age and the early Romano-British period, the building of ceremonial barrows and stone circles ceased, while people turned to constructing enclosed settlements, particularly hillforts. The Iron Age is also characterised by the introduction of iron tools and weaponry. At the time of Julius Caesar's expedition to Britain, southeast Wales was occupied by a people known as the Silures. There is evidence from the Gwent Levels for seasonal settlement sites and rectangular wooden buildings have been observed at Goldcliff (Bell et al. 2000). In contrast to the large hillforts found elsewhere in the country, these settlements appeared to have been undefended. There are no recorded heritage assets of Iron Age date in the study area.

***Roman (43AD to 410AD)***

7.5.15 The primary source of information for the Roman invasion of Wales is derived from the writings of Tacitus and Cassius Dio. The invasion into Wales followed the occupation of Britain by the Roman Empire in 43 AD, when the Emperor Claudius ordered the invasion into southeast England. Campaigns against the people Welsh peoples were launched by Ostorius Scapula, which began against the Deceangli in the north, then in 49 AD the offensive against the Silures of South Wales was undertaken (Mattingly 2007, 102)32. Evidence of Roman occupation in southeast Wales is widespread, such as the Roman market town at Caerwent, the Roman fortress at Caerleon and Roman fort at Cardiff Castle.

7.5.16 To the east of the study area at Rumney Great Wharf, Roman activity is suggested by a number of drainage ditches filled with Roman pottery, daub, bone and iron slag (GGAT 2017, 13)33. These ditches suggest that some sort of Roman settlement may have existed on the Levels and a Roman seawall may have existed to defend the reclaimed lands (Allen and Fulford 1986, 112). There were no records of Roman date within the study area.

***Early Medieval and Medieval (410AD to 1600AD)***

7.5.17 Following the withdrawal of the Romans, there is limited archaeological and documentary evidence relating to the Levels until the period of the Norman conquest. The area seems to have been subject to a period of flooding, possibly due to the failure of Roman sea defences (Rippon 1996, 38)26.

7.5.18 During the late 9th and early 10th centuries, southern Wales was subject to Viking raids. The placename 'Lamby', may have a Scandinavian origin. It is first documented in 1401 and includes the Old Norse suffix '-by- meaning farmstead/village (Ripon 1996, 37)26.

7.5.19 The Norman conquest of southeast Wales began in the 1070s, with evidence suggesting only a limited occupation of Gwent taking place in the early stages (Rippon

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[31] Allen, J. R L. (1995). Three Later Bronze Age Occupations at Rumney Great Wharf on the Wentlooge Level, Gwent. Archaeology in the Severn Estuary 6. Vol 6.

[32] Mattingly, D. 2007. An Imperial Possession: Britain in the Roman Empire, 54 BC - AD 409. Penguin UK.

[33] GGAT Projects (2017) Flood Defences, Afon Rhymney, Cardiff: Archaeological Desk-Based Assessment

1996, 61)26. The advance faltered in 1075 but resumed in the 1090s with the whole of southeast Wales being conquered in the following fifteen years (Rippon 1996, 61)26. The occupied territory remained in direct control of William I, and his son Henry I builds Camarthen in 1109. The Welsh revolt, and most of Wales is under Welsh control by the time Llywelyn Fawr dies in 1240. However, Edward I ends all revolts by killing the last of Llywelyn Fawr's descendants (Llywelyn ap Gruffudd and Dafydd ap Gruffudd), who were capable of bringing strong resistance and rebellion (see Treaty of Montgomery 1267). By 1535, Wales becomes England's first 'colony' via the Laws in Wales Acts 1535-1542.

7.5.20 The main English migration into southeast Wales took place during the late 11th to early 12th centuries. New manors and villages were partly settled by English tenants, though the proportion of English to Welsh is unclear (Rippon 1996, 63)26. The area formed part of the manor of Rumney, which in turn formed part of the Lordship of Wentloog (originally Gwynllwg in Welsh) (Bradney 1993)34. The place name also appears in various forms in documentary sources: Rompney, Romney, Remni, Remne, Rempey, Rumney, Rhymney and the Welsh Trederlerch all appear (Neal 2005, 1). While the centre of the manor lay upriver at Rumney, northwest of the development area, some activity seems to have occurred near the coast.

7.5.21 Two mills, Rumney Mill and New Mill, are recorded in the manorial records of 1466, but their locations are uncertain. It has been suggested that one may have existed at the mouth of the Pil Melyn stream – Melin equating to mill (Maynard 1995; Rippon 1996)26. The medieval mill (02788s) located within the study area may be the remains of one of these mills. Rippon (1996)26 also identifies a medieval sea defence along the eastern side of the Rhymney Estuary, but the course of this sea defence is uncertain.

***Post-Medieval (c.1540 AD), Industrial (1750 AD) and Modern (1900 AD to Present)***

7.5.22 From the early post-medieval period the manor of Rumney was held by the Morgan family of Tredegar. In 1590-91, the Court of Augmentations noted that the existing sea wall in the manor was in a poor state of repair and commissioned the construction of a new sea wall slightly further inland (Maynard 1995). This has been identified as the relict sea wall (GM474) that now survives as a Scheduled Monument, located approximately 800m to the east of the site boundary. Additional post-medieval sea defences are recorded within the study area, comprising a sea defence bank (02812.0s) located north of Splott Moors, as shown on 1st edition 1:10,560 Ordnance Survey (OS) map (Surveyed 1881 to 1882, published 1886).

7.5.23 The parish of Rumney, in which the eastern half of the development lies, formed part of Monmouthshire until 1974, though Roath Parish, on the west side of the estuary, lay in Glamorgan. Until the 20th century expansion of Cardiff, the parish was relatively sparsely populated, with a population of just 235 in 1801, which had grown to 540 by 1891.

7.5.24 In 1931 an aerodrome was set up on Pengam Moor, to the west of the study area. By 1936 this was known as Cardiff Municipal Airport, and consisted of wooden huts around a grass airstrip. With the outbreak of the Second World War, Pengam Moor was requisitioned by the Air Ministry and became RAF Cardiff, mainly flying transport and communication aircraft. A potential airfield structure (RE008) is recorded within the

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[34] Bradney, J. (1993) A History of Monmouthshire, Volume 5: The Hundred of Newport. Cardiff, Merton Priory Press.

study area.

7.5.25 Other assets of modern date identified within the study area include the following heritage assets: a modern slipway (03990s) currently in use by the Rhymney River Motor Boat Sail & Angling Club; a modern small arms range (0634a) recorded as being destroyed; a modern anti-invasion defence/decoy site (05870s/RE007) recorded as no longer extant; and, allotment gardens of modern date (RE006) recorded as partially destroyed.

### Monuments of unknown date

7.5.26 There were four records within the study area relating to heritage assets of unknown date. A drainage ditch or reen (02324s) is recorded as a heritage asset located near ST225777 on the south side of the Lamby Way Tip. The drainage ditch is noted as being visible on a small island of Little Wharf, but this small island no longer appears to be extant. Earthworks (05866s) are visible on the 1st edition 1:10,560 OS map and appear on subsequent maps until the 4th edition OS map (revised 1947, published 1951), and on aerial photographs until 1988 when they are subsequently buried by the Lamby Tip landfill site. A stone (05867s) is marked on the 1st edition OS map. The date of the stone is unclear and it does not appear on the 2nd edition OS map of 1901 and seems to be no longer extant.

### Historic mapping review

7.5.27 The earliest available historic map is the Joan Blaeu map of 1646, which labels the area as 'Rompley' and 'The Spittle'. A ca. 178- map entitled 'A Map of Lands in Rumney' (author unknown) shows landholdings in the manor of Rumney during the 1780's, showing several disparate parts of the parish. To seaward of the fields, a continuous pencilled line is shown, following the line of the defences shown on later maps, which are probably the sea defences.

7.5.28 A map from 1790 known as 'By West' by Robert Snell, shows part of Rhymney Great Wharf to the east of the study area, showing that the sea wall was in existence at this time, although its construction form is unclear. An 1823 'Survey of the Sea Walls and Banks in the Level of the Hundred of Wentllwg in the County of Monmouth from Rumney Bridge to Newport' by Thomas Wakeman, comprises a series of plan which details the state of sea defences in the area. The map shows the sea defences, most of which was simply an earthen bank at the time, but around the outlet of Pil Melyn stream, it was at least partly constructed of stone.

7.5.29 The 1840 'Tithe Map of the Parish of Roath' covers the area west of the River Rhymey, and shows very little. Most importantly, the coastline was shown as radically different from modern maps, as much as 400m further inland that it is today. The 1846 tithe map shows the sea defences following the modern course. Few manmade structures are shown in the vicinity of the development, with the exception of the aforementioned sea defences, a system of drainage ditches and two gouts. Comparison with modern maps shows that a significant amount of coastal erosion has taken place since 1846, with the loss of a significant amount of salt marsh seaward of the sea defences.

7.5.30 The 1st edition OS map (Surveyed 1881 to 1882, published 1886) shows little difference when compared with the tithe maps. The eastern side of the estuary remained a mixture of agricultural land and saltings. The defences themselves are shown as a bank, and the gouts on the earlier tithe maps are shown as sluices. The course of the river and the line of the coast appears similar to that in the earlier tithe maps, approximately 400m further northeast than today. The only other significant

difference is the addition of the Great Western Railway (GWR), which passes to the north of the study area.

7.5.31 The 2nd edition OS map (Revised 1898 to 1899, published 1901) shows very little change from the 1st edition. Railway sidings appear alongside the main Great Western Railway (GWR) line and just to the north of the study area, several brickworks are seen. Southwest of the river, the coastline appears to have retreated further. To the northeast, in the area of Rumney Great Wharf, there also appeared to have been some coastal erosion to the exposed saltmarsh, although it appears to have been much less pronounced here.

7.5.32 The 3rd edition OS map (Revised 1915 to 1916, published 1919) also shows few changes. The GWR has widened and the coast to the southwest has retreated further, but there is no other significant change to note.

7.5.33 The 4th edition OS map (Revised 1947, published 1951) depicts the creation of sea defences on the western side of the River Rhymney, which approximately follows the line of the modern Rover Way along the riverbank, although further southwest, the sea defences are set back from the coast. The line of Rover Way here approximately follows the coastline, which has retreated still further; comparison with the first edition OS shows that the shoreline has retreated some 100m inland. East of the river, the mapping between 1880 and 1921 suggests the loss of approximately 50m of saltmarsh. Outside the study area, large numbers of houses are shown being constructed to the west. RAF Pengam Moor is not shown on the map, but as it is a military asset, it would not have been mapped. Allotment gardens (RE006) are visible between Pengam Moor and the railway.

### Heritage events

7.5.34 A borehole survey was undertaken by GGAT at Lamby Way, producing borehole records BH 21 (E000988), BH22 (E000989), BH23 (E00990) and BH24 (E000991) in the study area. No archaeological finds or features were discovered (GGAT 2017). In BH22, thin lenses of peat were noted below 1.6m OD, concentrations of pear were noted between 1.11m and 0.61m OD, at 0.81m a lense c.3cm thick was recorded and lower black peat 0.15m thick was encountered at 0.11m. In BH22 layers of black rick peat were encountered at 1.4m OD and 0.1m OD. No palaeoenvironmental remains were encountered in boreholes BH21 or BH23.

7.5.35 Two previous desk-based assessments have been carried out in the area: the first was commissioned in March 1993 following proposed improvements to the sea defences between Cardiff and Sudbrook (Locock 1993 in GGAT 2017). A second desk-based assessment was carried out in May 1993 on the area of the Lamby Way Tip, following proposals to expand the landfill area (Wilkinson 1993). Neither identified sites of significant interest.

7.5.36 An evaluation was carried out on an extension to the Lamby Way Tip in 1997 in order to locate the remains of a medieval mill or remains of earlier sea defences. No archaeological features were discovered; the report suggest that any former sea defences either followed the line of the present-day defences, or were located further seaward (GGAT 2017).

### Site Visit

7.5.37 A site walkover survey was undertaken by GGAT on 9th January 2017 and 10th January 2017 full details of which are available in Appendix K.

7.5.38 Site visits were undertaken by GGAT on 9th January 2017 and 10th January 2017, in order to assess the condition of sites identified in the HER and NMR record any new sites of archaeological interest, full details of which are available in Appendix K. A subsequent site visit was completed by Kristian Evans of JBA Consulting on 8th February 2021, in order to ascertain the potential change in condition of those assets identified by GGAT within the study area. The weather during the JBA site visit was predominantly overcast with some patches of sun. The JBA site visit was restricted to areas that could be accessed from the Wales Coastal Path. This meant most of the east side of the Rhymney could not be surveyed due to restrictions access.

7.5.39 Location 11 is occupied by a mixture of beach shingle, and a dilapidated rock armour structure that is in the process of collapsing. To the immediate north of this location land is occupied by a strip of Saltmarsh, and further north of this, land is occupied by a solar farm and the Lamby Tip Historic Landfill. To the east of this location land along the foreshore is occupied by rock armour, behind which is infrastructure associated with the landfill site.

7.5.40 Location 21 is situated to the west of Location 11, on the outer edge of a meander of the River Rhymey. Land in this area is currently occupied by saltmarsh and steep muddy river banks. Land to the north east of the scheme is occupied by a solar farm, the spur of land extending outwards south west to the south of this location is primarily salt marsh and to the west across the river land is occupied by a sailing club.

7.5.41 Location 31 is located on the east bank of the River Rhymney to the east of the solar farm. The works take place on the banks of the River Rhymney, in front of a large line of trees that block views to the solar farm and beyond.

7.5.42 Works at locations 22, 32, 42 all take place on the west bank of the River Rhymey in areas that are already impacted by modern development. The works are bounded to the west by Rover Way and to the west by scrub, saltmarsh and the banks of the river. Works at Location 52 are to the east of the A4232 on an area of flood plain.

7.5.43 Location 12 is located along the sea front to the south of the River Rhymney (Drawing No.). Land in this area currently consists of a rocky beach littered with rubble that has potentially been unearthed as a result of erosion of the earth bank. The works in this area are bounded to the west by a residential development, to the south by allotment gardens, to the east by the A4232 and to the north by the Rhymney River.

7.5.44 No surviving ground traces of recorded sites were visible during the site visits, with the exception of the Pil Melyn Gout (RE001), the airfield structure (RE008) and the slipway (03990s) which is still in use by the Rhymney River Boat Club. Across the foreshore in areas where erosion was visible, many circular grey features could be discerned in the brown clay. It is possible that they may represent old vegetation such as tree stumps.

7.5.45 No new heritage assets were identified during either site visit.

### Ground Investigation Works

7.5.46 Ground Investigation works were undertaken by Quantum Geotechnic between February and May 2020 in order to inform on the existing ground conditions within the site boundary. The results of the ground investigation works were reported in the Ground Investigation Report (Appendix L) produced by JBA (JBA 2020).

7.5.47 Made ground was encountered between ground level and a maximum depth of 4.15mbgl with a maximum recorded thickness of 2.3m. Made ground was classified

either as cohesive made ground encountered between 9.2mAOD and 4.7m AOD, described as slightly sandy gravelly clay with a low cobble content, or granular made ground encountered between 9.3m AOD and 3.5m AOD, consisting of slightly clayey sandy gravel. Tidal Flat Deposits were recorded immediately below the made ground between 1.7m and 13.7mbgl (6.8m AOD and -5.2m AOD). with thickness between 6.8m and 10.3m. Where made ground was absent tidal deposits were recorded at the ground surface. The tidal flat deposits comprised a slightly gravelly slight sandy to sandy silty clay. Following the tidal flat deposits glaciofluvial deposits were recorded between 8.0m and 15mbgl (-0.4m and -6.1m AOD), with a maximum recorded thickness of 4.6m. The glaciofluvial deposits comprised well graded sandy gravel. Bedrock Mercia Mudstone Group was encountered between 10.2m and 15mbgl (-3.7m AOD and -9.3m AOD), and all boreholes that penetrated the bedrock terminated within it. No peat or other organic deposits were noted during the ground investigation works.

## 7.6 Assessment Methodology and Significance Criteria

7.6.1 The criteria for assessing the significance of heritage values is established through CADW's Conservation Principles for the sustainable management of the historic environment in Wales (2011). Principal 2 outlines four competent values which need to be considered to enable the assessment of a historic asset. These include evidential, historical, aesthetic and communal value. Table 7-1 outlines the values which has been compiled from 'Understanding heritage values and assessing significance' outlined in Principal 6 of the Conservation Principals (CADW 2011, 16) and Heritage Impact Assessments in Wales (CADW 2017, 7)[34].

**Table 7-1: Component values for the assessment of a historic asset**

| Value | Description |
|---|---|
| Evidential value | The extent to which the physical fabric tells how and when the historic asset was made, how it was used and how it has changed over time. There may be buried or obscured elements associated with the historic asset which may also be an important potential source of evidence (CADW 2017,7)[35].<br><br>'This derives from those elements of an historic asset that can provide evidence about past human activity, including its physical remains or historic fabric. These may be visible and relatively easy to assess, or they may be buried below ground, under water or be hidden by later fabric. These remains provide the primary evidence for when and how an historic asset was made or built, what it was used for and how it has changed over time. The unrecorded loss of historic fabric represents the destruction of the primary evidence. Additional evidential values can be gained from documentary sources, pictorial records and archaeological archives or museum collections. To assess the significance of this aspect of an asset, all this evidence needs to be gathered in a systematic way and any gaps in the evidence identified' (CADW 2011, 16). |

[35] Cadw (2017) Setting of Historic Assets in Wales.

| Value | Description |
|---|---|
| Historic value | The potential capacity of an asset to your historic asset may illustrate a particular past way of life or be associated with a specific person or event; there may be physical evidence for these connections which it could be important to retain (CADW 2017,7).<br><br>'An historic asset might illustrate a particular aspect of past life or it might be associated with a notable family, person, event or movement. These illustrative or associative values of an historic asset may be less tangible than its evidential value but will often connect past people, events and aspects of life with the present. Of course, the functions of an historic asset are likely to change over time, and so the full range of changing historical values might not become clear until all the evidential values have been gathered together. Historical values are not so easily diminished by change as evidential values and are harmed only to the extent that adaptation has obliterated them or concealed them' (CADW 2011 16-17). |
| Aesthetic value | The design, construction and craftsmanship of a historic asset. This can also include setting and views to and from the historic asset, which may have changed through time (CADW 2017,7).<br><br>'This derives from the way in which people draw sensory and intellectual stimulation from an historic asset. This might include the form of an historic asset, its external appearance and how it lies within its setting. It can be the result of conscious design or it might be a seemingly fortuitous outcome of the way in which an historic asset has evolved and been used over time, or it may be a combination of both. The form of an asset normally changes over time. Sometimes earlier pictorial records and written descriptions will be more powerful in many people's minds than what survives today. Some important viewpoints may be lost or screened, or access to them may be temporarily denied. To assess this aspect of an asset, again the evidence of the present and past form must be gathered systematically. This needs to be complemented by a thorough appreciation on site of the external appearance of an asset in its setting. Inevitably understanding the aesthetic value of an historic asset will be more subjective than the study of its evidential and historical values. Much of it will involve trying to express the aesthetic qualities or the relative value of different parts of its form or design. It is important to seek the views of others with a knowledge and appreciation of the historic asset on what they consider to be the significant aesthetic values' (CADW 2011, 17). |
| Communal value | The potential for a historic asset to have a particular significance to people for its commemorative, symbolic or spiritual value, or for the part it has played in local cultural or public life. This will be particularly important in the case of buildings in public use or sites where public access must be maintained or improved (CADW 2017,7). |

| Value | Description |
|---|---|
| | 'This derives from the meanings that an historic asset has for the people who relate to it, or for whom it figures in their collective experience or memory. It is closely linked to historical and aesthetic values but tends to have additional or specific aspects. Communal value might be commemorative or symbolic. For example, people might draw part of their identity or collective memory from an historic asset or have emotional links to it. Such values often change over time and they may be important for remembering both positive and uncomfortable events, attitudes or periods in Wales's history. Historic assets can also have social value, acting as a source of social interaction, distinctiveness or coherence; economic value, providing a valuable source of income or employment; or they may have spiritual value, emanating from religious beliefs or modern perceptions of the spirit of a place' (CADW 2011, 18). |

7.6.2 The Design Manual for Roads and Bridges (DMRB 2020), though not specifically focused on developments of this nature, provides a suitable, general framework for scoping and assessing environmental value, magnitude of impact and significance. The requirements for this assessment and reporting the effects on the environment as part of the process of construction, operation and maintenance projects is set out in LA104: Environmental Assessment and Monitoring (formerly HA 205/08, HD 48/08, IAN 125/15, and IAN 133/10) and LA106 Cultural Heritage Assessment (formerly HA 208/07, HA 60/92 and HA 75/01). This assessment framework will be used alongside JBA's in house assessment criteria to assess value, magnitude of value and significance of effect. The definition of values has been based on Table 3.2N presented in LA104 (DMRB 2020, 13).

**Table 7-2: Importance of heritage assets**

| Importance | Examples |
|---|---|
| Very High | World Heritage Sites<br>Places of international importance due to their 'outstanding universal value'. |
| High | Scheduled Monuments<br>Grade I or II* Listed Buildings<br>Grade I or II* Registered Parks and Gardens<br>Battlefields<br>Places or structures of national importance<br>Non-designated heritage assets of equivalent national importance or potential to contribute significantly to national research objectives |
| Medium | Grade II Listed Buildings<br>Grade II Registered Parks and Gardens<br>Conservation Areas<br>Non-designated assets of regional or high local importance with potential to contribute significantly to regional and local research objectives. This includes assets which have particular regional associations or may have important associations at a local level (e.g. they have significance to local population or embody something of the special identity of a locality). |
| Low | Locally Listed Buildings<br>Non-designated assets which are relatively poorly preserved or have limited importance at a local level and low potential to add to local and regional research objectives. |
| Negligible | Assets that have very limited or no archaeological, historical or cultural importance. |
| Uncertain | Sites where there is evidence that a heritage asset may exist, but where there is insufficient information to determine its nature, extent and degree of survival given current knowledge. |

7.6.3 The assessment criteria for the proposed change(s) and the impact they would have on cultural significance is outlined in Table 7-4. The process of evaluating the consequences of change can be usefully broken down into three distinct analytical stages:

7.6.4 **Change**: A factual statement of how a proposal would change an asset or its setting including physical, visual appearance, scale, nature and duration;

7.6.5 **Impact**: An assessment of the degree to which any changes would increase or decrease the cultural significance of an asset. Impact is scaled and the magnitude of impact is a reflection of the extent to which the cultural significance of an asset is changed by a proposal.

7.6.6 A judgement of magnitude of impact can be made based on the following criteria which has been based on the criteria for assigning magnitude of impact provided in Table 3.4N presented in LA104 (DMRB 2020, 14).

**Table 7-3: Magnitude of impact criteria**

| Magnitude of impact | Criteria |
|---|---|
| Major Negative | Causes total destruction or change to, most key elements of the asset that results in substantial loss of integrity and cultural significance. Comprehensive change to the setting of the asset which this is a critical aspect of the asset's cultural significance. Any such change would not normally be reversible. |
| Moderate Negative | Causes change to, or loss of many key elements which result in a moderate loss of integrity and cultural significance of the asset. Moderate changes to the setting of the asset where this makes an important contribution to the cultural significance of the asset. |
| Minor Negative | Change to some elements which lead to a limited loss of integrity and cultural significance of the asset. Change to the setting of the asset where this makes a limited contribution to the cultural significance of the asset. |
| Neutral/No Change | No appreciable change to the cultural significance of the asset or its setting. |
| Minor Positive | Change to some elements which leads to limited improvement in integrity and cultural significance of the asset, or arrests decline. Change to the setting of the asset where this makes a limited contribution to the cultural significance of the asset. |
| Moderate Positive | Causes change to many key elements which result in a moderate enhancement to integrity and cultural significance of the asset or reverses decline. Moderate changes to the setting of the asset where this makes an important contribution to the cultural significance of the asset. |
| Major Positive | Causes significant change to most key elements of the asset that results in substantial enhancement of cultural significance. Comprehensive change to the setting of the asset which this is a critical aspect of the asset's cultural significance. |

7.6.7 The significance of the effect of the proposals on heritage assets is determined by the interaction of receptor value/sensitivity and impact magnitude. Effects can be positive (i.e. enhance the heritage asset) or negative (i.e. detrimental to the resource). Table 7-3 above sets out the criteria adopted for this assessment and is based on the criteria set out in the DMRB guidance and JBA in-house assessment criteria.

7.6.8 **Effect:** A conclusion regarding whether an impact matters or not, reflecting the importance of the affected heritage asset. The effect is the measure that brings together the magnitude of the impact and the heritage asset's importance. This a critical stage of the assessment process as this determines the weight that should be given to the matter in either influencing the design of the proposal or ultimately in the test as to whether the proposal will be acceptable and permitted. The effect can be articulated through the use of a matrix which brings together the importance of an asset and the magnitude of impact on the assets significance. Where there are two options for a level of effect it is a matter of professional judgement which should be articulated in the text description as to the level of effect appropriately. Table 7-4 below sets out the criteria adopted for this assessment, which is based on the criteria set out in the DMRB guidance (LA104 2020, 14 - 15) and JBA's inhouse assessment criteria.

**Table 7-4: Impact significance criteria**

| Importance of asset | Magnitude of impact | | | |
|---|---|---|---|---|
| | Major | Moderate | Minor | Neutral |
| Very High | Very Large | Very Large/Large | Large/Moderate | Slight/Neutral |
| High | Very Large/Large | Large/Moderate | Moderate/Slight | Slight/Neutral |
| Medium | Large/Moderate | Moderate | Slight | Neutral |
| Low | Moderate/Slight | Slight | Slight/Neutral | Neutral |
| Negligible | Slight/Neutral | Slight/Neutral | Slight/Neutral | Neutral |

## 7.7 Potential Impacts and Significant Effects

### Assessment of significance and archaeological potential

***Designated Assets***

7.7.1 Scheduled Monuments are of national importance to Wales as they represent the cultural heritage of Wales and therefore have high significance. The Rumney Great Wharf Relict Sea Wall (GM474) is of national importance for its potential to enhance our knowledge of coastal defences. The monument has evidential value as the structure may be expected to contain archaeological information relating to its chronology and buildings techniques.

7.7.2 In the wider area the 'Rumney Pottery' building (13761) is located 400m to the north-west of the site. As a grade II Listed Building it is of medium significance and has evidential value through techniques used in its construction and materials. Its physical form also provides aesthetic value to the surrounding area. The building is currently utilised as a pottery shop, and therefore also has communal value to residents and visitors to the area.

7.7.3 Conservation Areas have medium significance. There are three Conservation Areas located between 1.3km-1.8km to the west of the site; they are as follows: Roath Mill Gardens, Roath Park and Oakfield Street. They provide communal and aesthetic value via the form and layout of protected buildings, layouts, structures and open spaces, which are enjoyed by residents and visitors alike.

***Non-designated Assets***

7.7.4 Non-designated heritage assets can range in importance from negligible to medium depending on the quality of their survival and any particular regional associations they may have. GGAT found all the non-designated assets within the study area to be of low or negligible importance, as shown in the Table 7-5.

**Table 7-5: Non-designated assets within the study area**

| ID | Site | Inter-related value | Value of asset |
|---|---|---|---|
| 02882s | Bronze- Age Spearhead findspot | The asset has the capacity to provide evidential value/physical evidence of prehistoric occupation. | Low |
| 02324s | Drainage Ditch of unknown date | The asset has the capacity to provide evidential value of how the area was utilised in the past. | Low |

| ID | Site | Inter-related value | Value of asset |
|---|---|---|---|
| 02788s | Medieval Mill | The asset has the capacity to provide evidential value of how the area was utilised in the Medieval period | Low |
| 02812.0s | Post-medieval sea defences, Splott Moors | The asset has the capacity to provide evidential value of how the area was defended from flood risk in the past. | Low |
| 03990s | Modern slipway | The asset has the capacity to provide historic value on the modern historic maritime use of the area. | Negligible |
| 05866s/RE002 | Earthworks, Lamby Fach of unknown date | The asset has the capacity to provide evidential value of how the area was utilised in the past, possibly as part of a drainage/sea defence network. | Low |
| 06434s | Modern small arms range | The asset has the capacity to provide historic value of the past WW2 military defence of the area. | Negligible |
| 05367s/RE003 | Stone of unknown date | The asset has the capacity to provide historical value of the past use of the area, but appears to no longer exist. | Low |
| 05870s/RE007 | Modern WW2 anti-invasion defence/decoy site | The asset has the capacity to provide evidential and historic value of the past military defence of the area. | Low |
| RE006 | Allotment gardens of modern date | The asset has the potential to provide historic and communal value of the modern public use of the area. | Negligible |
| RE008 | Modern WW2 airfield structure | The asset has the capacity to provide evidential and historic value of the past WW2 military defence of the area. | Low |

### Archaeological Potential

7.7.5 There is potential for the site to contain previously unknown archaeological remains, including geoarchaeological and palaeoenvironmental evidence that may be encountered during construction works associated with the scheme. The potential for archaeological remains to be present is considered on a period by period basis based on the environmental evidence any other known assets from the surrounding area. It is preceded by a brief assessment of the potential for geoarchaeological and palaeoenvironmental evidence within the site.

7.7.6 Ground investigation works show that made ground is located across the majority of the site. Any groundbreaking activities within made ground will have no potential for encountering remains of archaeological potential. Potential exists for encountering

archaeological remains in tidal flat deposits beneath made ground.

7.7.7 There is a low potential for geoarchaeological and palaeoenvironmental evidence dating to the Palaeolithic and Mesolithic periods to be present below made ground and tidal flat deposits. Geoarchaeological and palaeoenvironmental evidence has been encountered at sites on the Gwent levels. Two borehole records within the study area contained phragmites peat (E000989 and E00099), located to the east of the location 11 works. No other records within the study area were of geoarchaeological or palaeoenvironmental significance.

7.7.8 There is a low potential to identify sites or artefacts of Palaeolithic, Mesolithic or Neolithic date within the site. Palaeolithic, Mesolithic and Neolithic remains have been encountered at sites such as Sudbrook, Goldcliff and Uskmouth on the Gwent Levels, but there are no recorded assets dating to the Palaeolithic or Mesolithic within the study area. The potential is likely further reduced as the site has been subject and is continuing to be subject to tidal erosion, resulting in tidal deposits being redistributed and modern developments such as the Lamby Tip Landfill, roads and existing sea defences will have disturbed land within the site.

7.7.9 There is a low potential to identify sites or artefacts dating to the Bronze Age within the site. There is one recorded asset dating to the Bronze Age in the study area, an unstratified find of a side-looped spearhead found on estuarine clay (02882s). In the wider area three later Bronze Age occupation sites were identified at Rumney Great Wharf, and numerous temporary settlement sites have been identified on the Severn Estuary. As above, modern developments and erosion will have reduced the potential for encountering archaeological remains dating to the Bronze Age.

7.7.10 There is a low potential to identify remains dating to the Iron Age and Roman period within the site. Evidence for Roman activity is widespread in the wider area, with the Romans being the first to succeed in reclaiming the levels, and Roman activity is recorded at Rumney Great Wharf. There are no records of Iron Age or Roman date within the study area.

7.7.11 There is low potential to identify remains dating to the medieval period within the site. There is one record dated to the medieval period within the site, the medieval mill (02788s) but the survival of this asset is unclear. Medieval activity in the area is known from records relating to the manor of Rumney, and a medieval sea defence that ran to the east of the Rhymney Estuary. The remains of two mills are also recorded in the manorial records of 1466, one of which may be the medieval mill (02788s) recorded within the study area.

7.7.12 There is low potential for remains of post-medieval date to be identified within the site. The Manor of Rumney continued to be occupied during the Post-medieval period, and the Relic Sea Wall (GM474) was commissioned by the owners of the estate during this time. Within the study area are two records of post-medieval date, of which only one was identified during a site visit. The post-medieval sea defence bank (02812.0s) is recorded as a heritage asset within the study area but has likely been destroyed by modern development. The Pil-Melyn Gout (05865s) was identified during the 2017 site visit, located on the far east side of the study area. Both of these assets potentially relate to the Manor of Rumney and the Relic Sea Wall.

7.7.13 There is a low to moderate potential to identify remains dating to the modern period. Records within the study dating to the modern period represented the highest proportion of any date, with five records dating to this period. Of these five records only one could be identified during a site visit, the modern airfield structure (RE008),

which survives as a low-lying ruin. No other assets relating to the airfield are recorded in the HER or could be identified during the site visits, but there is potential to encounter them during construction of the scheme.

### Impact assessment

7.7.14 There will be no direct impacts on any designated heritage assets as a result of the proposed works. The consultation response from Cadw confirmed that impacts on designated heritage assets can be scoped out of the Environmental Statement (Cadw 2021).

7.7.15 Assessments have been made based on outline designs for Locations 12, 22, 32 and 31.

7.7.16 Two assets recorded within the study area lie within the footprint of the proposed works, and therefore may be directly impacted by the proposed development. The modern anti-invasion defence/decoy site (05870s/RE007) lies within the footprint of the works taking place at location 11. A drainage ditch of unknown date (02324s) potentially survives within the footprint of the rock armour in Location 11. The survival of this asset is unclear and no physical remains are visible from the surface. If some material remains of these assets survive below ground, construction works may result in minor to major negative impacts to those remains, depending on the proportion to which they are affected, and taking into account the extent of those remains, their state of preservation, the depths to which they survive, and their local significance. This would result in slight to moderate adverse negative impact to these assets.

7.7.17 Two assets lie outside the footprint of the permanent works but within the construction footprint which may lead to them being impacted by construction activities.

7.7.18 The modern airfield structure (RE008) is located close the earth embankment at Location 22. Construction works may result in minor to major negative impacts to the remains of this asset, depending on the proportion to which they are affected. This would result in slight to moderate adverse negative impact to the asset.

7.7.19 The medieval mill (02788s) is located to the east of the site boundary, outside of the footprint of the Location 11 rock armour. If some material remains of the asset survive below ground, construction works may result in minor to major negative impacts to those remains, depending on the proportion to which they are affected, and taking into account the extent of those remains, their state of preservation, the depths to which they survive, and their local significance. This would result in slight to moderate adverse negative impact to this asset.

7.7.20 Groundbreaking activities will take place during the construction phase of the scheme at all locations. Groundbreaking undertaken during construction of the rock armour at location 12 will be encounter a layer of made ground down to a depth of approximately 5m AOD, at which point tidal flat deposits will be encountered (JBA 2020). The potential for encountering unknown archaeological remains is confined to the tidal flat deposits. Therefore, there is a low potential for encountering unknown archaeological remains. If unknown archaeological remains are encountered, then the impact would depend on the level of survival and the importance of those discovered remains.

7.7.21 Access to the location 12 works will be via three routes. Access 12.2 will be via an existing road leading through an existing industrial estate, there is no potential to encounter unknown archaeological remains. The main access 12.1 will be via an existing layby approximately 100m north of Seawall Road, any groundbreaking would

only impact on made ground. The third access route will be located between Location 12 and Location 22, and will service both areas. Construction of this access route would only impact on made ground. The site compound at Location 12 will be located adjacent to the main access route, construction will only impact on made ground. Blockstone stockpiles will be located on an area of land to the south of the dirt bike track and north of the water treatment works and the other to the immediate southeast of the site compound. Only made ground will be impacted during construction of the stockpiles.

7.7.22 At Location 11 groundbreaking will impact a layer of made ground to a depth of approximately 2m AOD, at which point tidal flat deposits will be encountered. The potential for encountering unknown archaeological remains is confined to the tidal flat deposits. There is a low potential for encountering unknown archaeological remains within these tidal flat deposits, and any surviving remains are likely to be of low importance. If unknown archaeological remains are encountered then the impact would depend on the level of survival and importance of those remains. Peat was recorded in boreholes BH22 and BH24 (E000989 and E000991) at depths of 1.11m OD and 1.4m OD respectively. The peat lies below the maximum groundbreaking depths of the construction, and there is a low potential to encounter palaeoenvironmental remains. If palaeoenvironmental remains are encountered the impact would depend on the level of survival and importance of those remains.

7.7.23 Access to location 11 will be via an existing track leading from the Cardiff HWRC, and there will therefore be no impacts on unknown archaeological remains. A site compound will be established to the north of location 11 on land formerly used by the Lamby Way Tip Landfill Site. The establishment of the site compound will only impact on made ground, and there is therefore no potential to encounter unknown archaeological remains. A blockstone stockpile will be located immediately to the rear of the proposed rock armour revetment within the Lamby Tip Historic Landfill site. Any groundbreaking required for the stockpile will only impact on made ground, and there is no potential to encounter unknown archaeological remains.

7.7.24 The construction phase at Locations 22, 42 and 52 will require groundbreaking to facilitate construction of earth embankments. At location 22 groundbreaking will only impact on made ground. At location 42 and 52, groundbreaking activities will impact on made ground and tidal flat deposits which were encountered at ground level in one windowless sampling borehole in this area (JBA 2021). The potential for encountering unknown archaeological remains is confined to the tidal flat deposits. Therefore, there is a low potential for encountering unknown archaeological remains. If unknown archaeological remains are encountered, then the impact would depend on the level of survival and the importance of those discovered remains.

7.7.25 Access to location 22 will be via three proposed routes. The first will be used for both location 22 and 12 as described above. The second route will be via the boat club access track on existing hardstanding, and there are therefore no impacts on buried archaeology. The third would be constructed on the northwest end of location 12, and would only impact on made ground. Access to Locations 42 and 52 would be from Lamby Way, tidal flat deposits will be impacted at ground level by the access route, and there is therefore a low potential to impact on unknown archaeological remains. The magnitude of impact would depend on the level of survival and the importance of those discovered remains.

7.7.26 Locations 21, 31 and 32 will require erosion protection works that will involve groundbreaking activities. Groundbreaking activities and installation of sheetpiling will impact on tidal flat deposits, therefore there is a low potential for encountering unknown archaeological remains. If unknown archaeological remains are encountered,

then the impact would depend on the level of survival and the importance of those discovered remains.

7.7.27 Location 31 would be accessed first via roads within the Cardiff HWRC, and then by a new access route created to the north of the solar plant. Construction in this area would only impact on made ground.to be combined with 1.7.3

7.7.28 There will be no indirect impacts on Listed Buildings, Scheduled Monuments, Registered Parks & Gardens, Conservation Areas, Battlefields or Protected Wreck Sites. The Scoping response from Cadw confirmed that the above designated assets could be scoped out of the Environmental Statement, and that the Gwent Levels Historic Landscape of Outstanding Historic Interest in Wales should be assessed using the methodology outlined in the Setting of Historic Assets in Wales (Cadw 2017).

7.7.29 Location 11 is the closest to the Gwent Levels, with works in this area taking place adjacent to the Historic Landscape. Currently this location is not considered to provide a positive contribution to the setting of the Registered Historic Landscape. The impact of the rock armour on the setting of the Registered Historic Landscape at Location 11 is considered to be neutral. Construction of rock armour will result in vehicle movements along access routes and on the foreshore, plant activity, storage of materials, impacts on the setting of the Gwent Levels during construction of the scheme will be temporary minor.

7.7.30 Location 21 works are located in an area that has already been subject to modern development, and the nature of the works are not considered to significantly alter the character of the setting of the Gwent Levels. During construction there will be temporary impacts arising from plant activity. This will result in a temporary minor negative impact on the setting of the Gwent Levels.

7.7.31 Works at Location 31 are screened from the Gwent Levels by the solar farm and the line of trees, and the character of the area will not significantly change as a result of the installed erosion measures. The impact of the works on the Gwent Levels during operation of the scheme is considered to be neutral. Impacts will arise during the construction of the scheme as a result of construction activities and will result in a minor temporary negative impact.

7.7.32 Locations 22, 32, 42 and 52 are not considered to positively contribute towards the setting of the Registered Historic Landscape. Grassed earth embankments and soft engineering erosion protection will result in a neutral change in the character of these areas, and as a result will have a neutral impact on the setting of the Registered Historic Landscape. During construction there will be a minor temporary negative impact on the setting of the Gwent Levels as a result of construction activities.

7.7.33 The northeast end of Location 12 has clear views across to the Registered Historic Landscape across the Severn estuary. This area does not provide a positive contribution to the setting of the Gwent Levels, due to the poor quality of the beach and the large amount of rubble and other litter. Installation of rock armour in this location would result in a general improvement of the aesthetic quality of the area. During operation of the scheme there would be a neutral impact on the setting of the Gwent Levels. During construction there would be a minor temporary negative impact on the setting of the Gwent Levels as a result of construction activities.

7.7.34 Overall, the impact of the scheme on the setting of the Gwent Levels during its operation is considered to be neutral. The area around the River Rhymney is not considered to be currently providing a positive contribution to the setting of the Gwent

Levels, and in many places is causing a negative impact. Modern developments between the scheme and the wider Gwent Levels also provide screening that reduces the impact of the scheme. The west bank of the Rhymney features modern developments and infrastructure, and the proposed works will not negatively change the character of the area. During construction there will be minor temporary impacts on the setting of the Gwent Levels arising as a result of plant activity, vehicle movements and material storage.

## 7.8 Mitigation Measures

7.8.1 Direct impacts to the archaeological resource can be reduced through mitigation. Based on the potential impacts identified above, and consultation with Cadw and GGAT, the following mitigation measures are considered appropriate to reduce the impact of the scheme on the heritage resource.

7.8.2 No Listed Buildings, Scheduled Monuments, Registered Parks & Gardens, Conservation Areas or Protected Wreck sites will be impacted by the scheme, and as such mitigation requirements have not been considered.

7.8.3 The works will directly impact on the non-designated heritage assets which lie within the footprint of the proposed works. These are;

- The Modern anti-invasion defence/decoy site (RE007) potentially lies within the footprint of the Location 21 works, though its survival is unclear.
- Drainage ditch of unknown date (02324s) potentially lies within the footprint of the Location 11 works, though its survival is unclear.
- It is recommended that any groundbreaking activities within the vicinity of these assets are subject to archaeological monitoring in the form of a watching brief carried out by a suitably qualified archaeologist. The watching brief should be carried out in accordance with a Written Scheme of Investigation approved by Glamorgan-Gwent Archaeological Trust.
- Two assets lie outside of the footprint of the development, but may potentially be impacted by construction activities. These are;
- Modern airfield structure (RE008) that survives as a low-lying ruin,
- Medieval mill (02788s) which does not survive above ground, but foundations may exist.

7.8.4 It is recommended that both of these assets are fenced to protect from vehicle movements or accidental damage during construction. The type of fencing and buffer distance around the assets will be confirmed prior to construction beginning.

7.8.5 There is a low potential for groundbreaking activities associated with construction of rock armour to encounter previously unknown buried archaeological remains, specifically in those areas where works encounter tidal flat deposits. There is also a low potential for works at Location 11 to encounter paleoenvironmental deposits in the form of peat. It is recommended that any further pre-construction ground investigation works are monitored and the results analysed to further determine the potential for encountering unknown archaeological remains and palaeoenvironmental deposits. Following the GI works the requirement for implementation of a suitable scheme of mitigation such as monitoring through a watching brief can be determined.

7.8.6 During construction there will be temporary minor impacts on the setting of the Gwent Levels Historic Landscape of Outstanding Historic Interest in Wales arising from construction activities. The impact on the setting of the Gwent Levels will be neutral

during the operation of the scheme. Existing mitigation in the form of modern developments located between the site boundary and the Gwent Levels will reduce the impacts of the scheme on the wider historic landscape.

# 8 Climate Change

## 8.1 Introduction

8.1.1 This chapter is split into two sections. The first covers Climate Change Resilience, which will consider the resilience of the proposed development to climate change and the impact of the proposed development on the resilience of local receptors to climate change and any potential adaptation measures required. The second section covers GHG Emissions resulting from the proposed development over its lifetime compared against baseline and alternative emission scenarios and a consideration of opportunities to reduce these emissions

## 8.2 Legislative and policy setting

8.2.1 The Table 8-1 8-1 below sets out the relevant legislative and policy context for this EIA.

**Table 8-1. Key legislation and Policy relating to Climate Change in Cardiff**

| Scale | Legislation or Policy | Key points |
|---|---|---|
| National | The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 | Schedule 4 Paragraph 4 of the EIA Regulations, sets out the requirements for information to be included in the ES includes (*inter alia*) '*a description of the factors specified in regulation 4(2) likely to be significantly affected by the development:…climate (for example greenhouse gas emissions, impacts relevant to adaptation)…'*.<br>Schedule 4 Paragraph 5 also needs to be addressed as follows: '*A description of the likely significant effects of the development on the environment resulting from, inter alia… (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change…'*. This relates to the additional impact on the project arising from its vulnerability to a changing climate. |
| | The Well-being of Future Generations (Wales) Act 2015 | The Well-being of Future Generations (Wales) Act 2015 establishes a 'sustainable development principle' which means that a defined public body must act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs. In order to achieve this principle Welsh Government expects all those involved in the planning system to adhere to (inter alia):<br>putting people, and their quality of life now and in the future, at the centre of decision-making;<br>taking a long-term perspective to safeguard the interests of future generations, whilst at the same time meeting needs of people today;<br>respect for environmental limits, so that resources are not irrecoverably depleted or the environment irreversibly damaged. This means, for example, mitigating climate change, protecting and enhancing biodiversity, minimising harmful emissions, and promoting sustainable use of natural resources;<br>tackling climate change by reducing the greenhouse gas emissions that cause climate change and ensuring that places are resilient to the consequences of climate change;<br>applying the precautionary principle. Cost-effective measures to prevent possibly serious environmental damage should not be postponed just because of scientific uncertainty about how serious the risk is;<br>using scientific knowledge to aid decision-making, and trying to work out in advance what knowledge will be needed so that appropriate research can be undertaken…' |
| | The Environment Act (Wales) 2016 | The Environment Act (Wales) 2016 aims to position Wales as a low carbon, green economy, ready to adapt to the impacts of climate change. Key parts of the act that are particularly relevant to sustainability and climate change include:<br>Part 1: Sustainable management of natural resources – enables Wales' resources to be managed in a more proactive, sustainable, and joined-up way.<br>Part 2: Climate change – provides Welsh Ministers with powers to put in place statutory emission reduction targets, including at least an 80% reduction in emissions by 2050[36] and carbon budgeting to support their delivery. |
| | The Climate Change (Interim Emissions Targets) (Wales) Regulations 2018 | *The Climate Change (Interim Emissions Targets) (Wales) Regulations 2018* set decadal targets that represent a pathway to the 2050 target of emissions reductions of at least 80%. The Welsh Ministers are required to set each interim target at a level that they are satisfied is consistent with meeting the 2050 target as follows:<br>The maximum amount for the net Welsh emissions account for 2020 is 27% lower than the baseline. |

[36] In June 2019, the Welsh Government accepted the Committee on Climate Change recommendations for a 95% reduction in greenhouse gas emissions and went further with an ambition to reach net zero by 2050. https://gov.wales/wales-accepts-committee-climate-change-95-emissions-reduction-target

| Scale | Legislation or Policy | Key points |
|---|---|---|
| | | The maximum amount for the net Welsh emissions account for 2030 is 45% lower than the baseline.<br>The maximum amount for the net Welsh emissions account for 2040 is 67% lower than the baseline. |
| | The Climate Change (Carbon Budgets) (Wales) Regulations 2018 | *The Climate Change (Carbon Budgets) (Wales) Regulations 2018* set the maximum total amount for the net Welsh emissions account (a carbon budget) for the first two budgetary periods, 2016-2020 and 2021-2025, provided for in section 31(3) of the Environment (Wales) Act 2016. The first carbon budget for 2016-20 requires an average reduction of 23% against the baseline. The second carbon budget for 2021-25 requires an average reduction of 33%. |
| | Planning Policy Wales | Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It translates the Welsh Government's commitment to sustainable development into the planning system, so that it can plan an appropriate role in moving towards sustainability. The primary objective of PPW is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales, as required by the Planning (Wales) Act 2015, the Well-being of Future Generations (Wales) Act 2015 and other key legislation. |
| | Technical Advice Note (TAN) 15: development and flood risk | TAN 15 (2004) recognises that sea level rise and increased storminess are some of the most likely effects of climate change, to which Wales will need to adapt in the future. The note states it is necessary to take account of the potential impact of climate change over the lifetime of development, with 75 years assumed to be the lifetime for non-residential development.<br>The TAN 15 sits alongside with CL-03-16 (see below) and FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities—Climate Change Impacts[37]. All of these documents set out climate change allowances that should be used in in flood consequence assessments submitted in support of relevant planning applications, and to inform development plan allocations. The allowances used in TAN 15 originate from Environment Agency Flood and Coastal Defence Appraisal Guidance [38]. The Regional Sea Level allowances used in FCDPAG3 were taken up from the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report High Estimates. |
| | CL-03-16 Climate change Allowances for Planning | Policy Clarification Letter CL-03-16 sets out the requirements of TAN 15 with regard to the climate change allowances for planning. Associated Flood Consequences Assessment guidance refers to the source of the new requirements in FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities—Climate Change Impacts. This discusses in detail that the response to climate change requires appropriate decisions on whether to consider a managed adaptive approach or whether to adopt a more precautionary approach to coastal defence. The managed adaptive approach involves tracking the change in risk and managing this through multiple interventions. |
| | UK Climate Change Risk Assessment | Under the Climate Change Act (2008), the UK Government is required to publish a Climate Change Risk Assessment ('CCRA') every 5 years, which sets out risks and opportunities as a result of climate change. The first was published in 2012, with the second in 2017, and the third currently in development to be published in 2022. The aim of the assessment is to understand the urgency needed in further action to tackle current and future risks from climate |

[37] Available from: https://www.thenbs.com/PublicationIndex/documents/details?Pub=DEFRA&DocID=280606
[38] Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/481768/LIT_4909.pdf

| Scale | Legislation or Policy | Key points |
|---|---|---|
| | | change and understand what opportunities may arise. The current UK CCRA from 2017 identified that the greatest direct climate change threats in the UK are increased flood risk, exposure to high temperatures and heatwaves, water shortages, risks to ecosystems, impacts to food production, and new pests and disease.<br>As part of the UK CCRA, a national summary has been produced for Wales. The trends in Wales are broadly similar to those projected across the UK, including increases in temperature extremes by 1°C since the 1950's, although there have been no significant changes to average annual rainfall over Wales. |
| | Prosperity for All: A low carbon wales | In 2016 the Climate Change, Environment and Rural Affairs (CCERA) Committee established an Expert Reference Group to scrutinise climate change, action and progress in Wales. The Group expressed disappointment at the targets recommended by the UK Climate Change Committee at the time. CCERA also suggested a lack of ambition in Wales originated from the *Climate Change Strategy for Wales*[39]. The Climate Change Strategy for Wales sets out an adaptation framework to present a coordinated approach to the risks and opportunities that climate change presents, and to ensure Wales is well placed to adapt to the risks of climate change. However, since then the Welsh Government has committed to achieving a carbon neutral public sector by 2030[40] and has published *Prosperity for All: A Low Carbon Wales*[41], which sets out 100 policies and proposals to meet the 2020 carbon emissions targets. Furthermore the Welsh Government has since made a climate change emergency declaration in April 2019[42] and in June 2019 has accepted the recommendation in the Committee on Climate Change report (Net Zero – The UK's contribution to stopping global warming) of 95% reduction in Wales' GHG emissions by 2050, and has indicated an ambition to reach net-zero by 2050[43] to reflect the UK Government's aspirations for reducing greenhouse house emissions. |
| | Prosperity for all: A Climate Conscious Wales | In December 2018 through to March 2019 a Draft Climate Change Adaptation plan for Wales was consulted on. Since then, the Prosperity for all: A climate Conscious Wales report has been published. This report is designed to demonstrate that the Welsh Government understands the seriousness of the climate emergency and is taking steps to adapt to these changes. The plan sets out adaptation measures for those risks identified as 'most urgent' by the UK CCRA and outlines over 30 commitments to adaptation across all sectors. The main areas of action are:<br>Protecting people, communities, buildings and infrastructure from flooding;<br>Protecting public water supplies from drought and low flows;<br>Tackling land management practices that increase flood risk;<br>Risks to ecosystems and agriculture businesses;<br>Cross-cutting actions. |
| Local | One Planet Cardiff: Draft strategy | In response to the climate emergency, Cardiff has developed a draft strategic response, 'One planet Cardiff Strategy'. The council has a target to be carbon neutral by 2030, and this strategy sets out how this could be achieved. The document primarily focuses on the current challenges around the climate emergency and the actions already taken or have been agreed. The strategy has 7 key themes; energy, waste, built environment, food, green infrastructure and |

39 https://gov.wales/docs/desh/publications/101006ccstratfinalen.pdf
40 https://gov.wales/welsh-public-sector-be-carbon-neutral-2030
41 https://gweddill.gov.wales/docs/desh/publications/190321-prosperity-for-all-a-low-carbon-wales-en.pdf
42 https://gov.wales/welsh-government-makes-climate-emergency-declaration
43 https://gov.wales/wales-accepts-committee-climate-change-95-emissions-reduction-target

| Scale | Legislation or Policy | Key points |
|---|---|---|
| | | biodiversity, water, and transport.<br><br>At the time of writing this, the draft strategy is currently in consultation stage, with the consultation open until 11th December 2020. |

## 8.3 Climate Change Resilience and Adaptation

8.3.1 This section of the chapter considers the climate change resilience of the site, both currently and in future, and the impact the proposed development will have on this resilience. In this section, the proposed development as a receptor in the context of climate change impacts. The impact the proposed development is likely to have on climate change, in terms of greenhouse gas emissions, is considered in a later section (Section 8.7).

8.3.2 This does not preclude that the current proposals could be extended or modified at a later date, depending on how realisation of the impacts of climate change affect the standard of protection provided by the coastal defences. A managed adaptive approach to climate change is considered to be in line with current planning policy.

### Assessment Methodology and Significance Criteria

***Scope of Assessment***

8.3.3 The method of assessment adopted in this chapter comprises the following principal stages:

**Baseline**

| | |
|---|---|
| *(a) Existing conditions (historic climate and current site use)* | A review of historic weather trends, significant weather events and site conditions to understand the current climatic conditions and hazards impacting the site. |
| *(b) Future scenario - UKCP18 projections* | Future climate projections have been analysed as part of the methodology for this EIA assessment. Climate trends and projections are published by the Met Office on the UK Climate Projections website. The UK Climate Projections 2018 ("UKCP18") became available in November 2018 and provide the most up to date assessment of how the climate of the UK may change over this century. |
| *(c) Climate drivers and hazards* | Based on the historic climate events, climate projections and stakeholder consultation the pertinent climate drivers (e,g. increased precipitation) for the site and the associated hazards (e.g. flooding) are identified for current and future (2080-2099) epochs. |
| *(d) Sensitive receptors* | In order to assess the climate change impacts of future climate hazards, it is necessary to split the assessment to account for different land uses and receptors. Potential risk (exposure and consequence) is assessed for each climate hazard and any required adaptation measures identified. |

## Potential Effects

| | |
|---|---|
| *(a) Embedded adaptation* | Adaptation measures inherent to the site location, layout and design are outlined and taken into consideration when determining exposure to and consequence of climate hazards to sensitive receptors. |
| *(b) Local receptors* | Consideration of the impact of the development on the ability of local receptors outside of the project boundary to demonstrate resilience to future climate hazards. |
| *(c) Exposure Assessment* | This stage assesses the degree to which the site is currently affected by climate hazards and the degree to which it is likely to be affected in the future for the agreed epochs (UKCP18 projections). A scoring approach will be developed to score the probability of climate hazards occurring on a 0-3 (no to high) basis.<br>The Exposure Assessment is undertaken for both construction and operational development lifecycle stages. |
| *(d) Consequence Assessment* | This stage involves assessing how the identified climate hazards could affect the site assets and operations. The sensitivity analysis seeks to identify sensitivity of project aspects and activities to climate hazards independent of the specific location.<br>The scoring approach relates to the degree of damage to assets or the potential for operations to be affected or cease to function and what the implications of these could be more widely (e.g. the area was isolated due to a flood event). This scoring approach relates to the social, economic and environmental impacts that could result from climate hazards occurring.<br>The Consequence Assessment is undertaken for both construction and operational development lifecycle stages. |
| *(e) Significance of Effect Assessment* | This stage combines the results from the two previous stages (exposure assessment score x consequence assessment score). This stage results in significance of effect scores for each receptor for current and future (2080-2099) epochs.<br>The Significance of Effect Assessment is undertaken for both construction and operational development lifecycle stages. |

***Adaptation and Monitoring***

8.3.4 This stage proposes adaptation measures to increase receptor resilience and reduce the significance of effect of climate hazards on the receptors. Adaptation is proposed for both construction and operational development lifecycle stages.

***Residual Effects***

8.3.5 This stage re-assesses the significance of effect following implementation of the proposed mitigation measure. Significance of effect scoring is re-assessed to determine change accounting for mitigation. Residual effects are considered for receptors at both construction and operational development lifecycle stages.

***Significance Criteria***

8.3.6 The significance of effect for climate resilience is determined through a methodology based on the UKCIP Risk Framework together with EU guidance for project managers assessing the climate resilience of vulnerable assessments (European Commission,n.d.). This is an industry recognised approach.

8.3.7 The methodology determines the exposure of receptors to identified climate hazards, and the consequence of impact of climate hazards on receptors. Combined, the output scores from each of these assessments determine the significance of effect. This is illustrated in Figure 8-1.

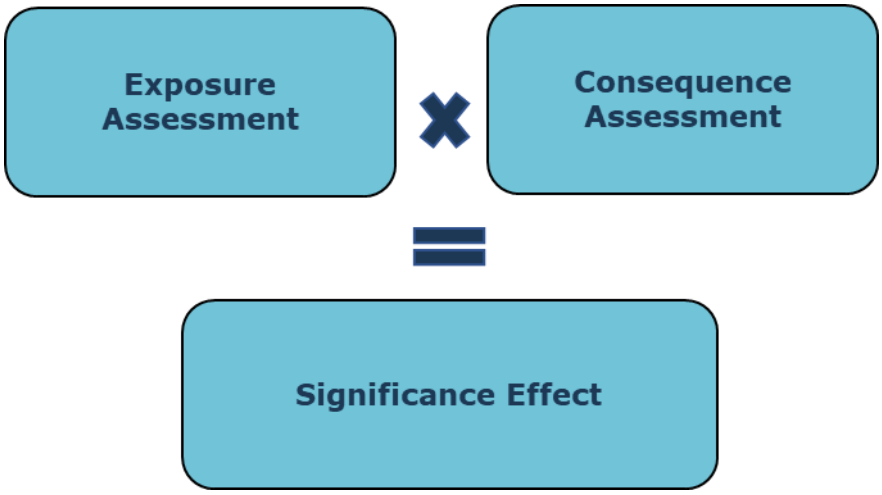


**Figure 8-1. Significance Effect Methodology**

***Scoring Methodology***

8.3.8 The following tables provide the scoring matrix used for each element of the Significance Assessment.

### Table 8-2. Scoring matrix used for the exposure assessment

| Exposure assessment | | | |
|---|---|---|---|
| High (3) | Medium (2) | Low (1) | None (0) |
| Recent evidence of this climate hazard occurring in the last 10 years and is expected to occur in most circumstances. | Evidence of this climate hazard occurring in the last 50 years and is likely to occur. | Little evidence of this climate hazard occurring in the past and may occur in exceptional circumstances. | No evidence of this climate hazard occurring in the past. Unlikely to occur. |

### Table 8-3. Scoring matrix used for the consequence assessment

| Consequence assessment | | | |
|---|---|---|---|
| High (3) | Medium (2) | Low (1) | None (0) |
| Property destroyed or not safe to use / fatality or multiple injuries.<br>Financial loss > £100,000<br>Failure of key objectives and/or key services<br>National media coverage | Moderate damage requiring repair / Injury requiring medical treatment.<br>Financial loss from £10,000 to £100,000<br>Medium impact on achievement of objectives; Some to significant localised press coverage. | Minor damage or injury.<br>Financial loss < £10,000<br>Minor impact on achievements of objectives<br>Minimal damage to reputation. | No damage, injury or financial loss.<br>No minor impact on achievements of objectives<br>No damage to reputation.<br>Potential positive impact. |

#### *Categories of Significance of Effect*

8.3.9 Significance of Effect is defined as a product of the consequence and exposure and is calculated by multiplying their respective scores. The combined score is categorised (negligible to substantial adverse) to determine the Significance of Effect. A Significant Impact is defined as being a climate event falling within the Substantial Adverse (red) category, as a result of scoring medium (2) or high (3) in the Exposure and Consequence assessments. A summary can be seen in Table 8-4 and Table 8-5 8-5 below.

### Table 8-4. Significance of Effect Scoring and Categorisation

| Consequence | Exposure | | | |
|---|---|---|---|---|
| | None 0 | Low 1 | Medium 2 | High 3 |
| None 0 | 0 | 0 | 0 | 0 |
| Low 1 | 0 | 1 | 2 | 3 |
| Medium 2 | 0 | 2 | 4 | 6 |
| High 3 | 0 | 3 | 6 | 9 |

### Table 8-5. Definitions for each significance category

| Significance Score (consequence x exposure) | Significance | Definition |
|---|---|---|
| 0 | Neutral/negligible | No detectable or material change to a location, environment, species or sensitive receptor. |
| 1, 2 (green) | Minor adverse | Slight, very short or highly localised negative effects.<br>A detectable but non-material change to a location, environment, species or sensitive receptor. |
| 3 (amber) | Moderate adverse | Limited negative effects which may be considered significant.<br>A material, but non-fundamental change to a location, environmental, species or sensitive receptor. |
| 4, 6, 9 (red) | Substantial adverse | Considerable effects (by extent, duration or magnitude) or of more than local significance or breaching identified standards or policy.<br><br>A fundamental change to location, environment, species or sensitive receptor. |

## Baseline Conditions

### *Historic and Existing conditions*

8.3.10 The UK Committee for Climate Change recently released their third Climate Change Risk Assessment (CCRA) (June 2021). The Summary for Wales Report identifies key trends and patterns observed in Wales:

- An increase in average annual temperature of 0.9°C from mid-1970s to mid-2010s.
- An increase in average mean rainfall of 2% from mid-1970s to mid-2010s.
- An increase in sunshine of 6.1% from mid-1970s to mid-2010s.
- There has been a UK wide increase in extreme heat events, however little evidence of changes to extreme rainfall.
- UK-wide sea levels have increased ~1.3mm per year since 1901.
- Future projects for Wales as listed in the CCRA include:
- Annual temperatures are expected to rise by approximately 1.2°C the 2050's and between 1.3°C and 2.3°C by the 2080s (from a 1981-2000 baseline)
- Winter rainfall is expected to increase by approximately 6% by the 2050s and between 7-13% by the 2080s (from a 1981-2000 baseline)
- Summer rainfall is expected to decrease by approximately 15% by the 2050's and between 18-26% by the 2080s.
- The frequency and intensity of extreme temperature and rainfall events may increase in future. In summer, whilst rainfall amounts are projected to decrease, rainfall is expected be more intense.
- Considering scenarios for Cardiff, sea level is expected to rise between approximately 22-28cm by the 2050's, and by approximately 43-76cm by the 2080s (from a 1980-2000 baseline).

In 2018, climate trends in the UK show (Royal Meteorological Society, 2019):

- Temperatures; 2018 was the 7th warmest year, with the equal warmest summer. The most recent decade (2009-2018) was on average 0.3˚C warmer than 1981-2010 and 0.9˚C warmer than 1961-1990.
- Snow: Significant snowfall occurred in February-March 2018, the most since December 2010. Generally, the number and severity of snowfall events has declined since 1960.
- Precipitation: June 2018 was the driest June since 1925. In the most recent decade (2009-2018), UK summers have been on average 11% wetter than 1981-2010 and 13% wetter than 1961-1990. Winters were 5% and 12% wetter respectively.
- Sunshine: May-July 2019 was the sunniest 3-month period in the UK on record. The most recent decade (2009-2018) has had 4% more hours of bright sunshine than 1981-2010 and 7% more than 1961-1990.
- Storms: 10 named storms affected the UK in 2010. The overall number and severity of storms has not seen significant changes in recent decades.
- Sea-level rise: Mean sea level rise around the UK is approx. 1.4mm per year since the start of the 21st century.

***Sea level rise***

- There has been a detectible rise in mean sea levels over the last fifteen years and a rising trend of 2.4mm/yr-1 on the Severn estuary.

***Storm Surge***

- Storm Callum in 2018 flooded walkways around Cardiff Bay[44].

***Heavy rain-related events:***

- A flood event in 1979 led to wide-spread devastation to communities in Cardiff, flooding approximately 3,000 homes.
- During the winter of 2006/07, heavy rainfall caused local sports pitches to become waterlogged. This led to a 16% decrease in income for Parks Services[45].
- In August 2014, ex-hurricane Bertha caused Cardiff to receive the UK's heaviest rainfall, with 45.2mm falling in just 12 hours[46].
- On the weekend of the 15-16 February 2020, Storm Dennis flooded large parts of south Wales. Wales was the wettest region as the UK suffered its wettest February since records began. 200 tonnes of debris had to be cleared from Cardiff Bay[47].
- Weeks later at the end of February 2020, Storm Jorge brought heavy rain lead to a critical incident being declared by South Wales Police in Cardiff. Railway lines were closed between Bridgend and Cardiff.
- In August 2020, Storm Francis led to the flooding of railway lines between Cardiff and Neath[48].

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[44] https://www.walesonline.co.uk/news/wales-news/incredible-pictures-flooded-cardiff-bay-15276662
[45] http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747
[46] https://www.walesonline.co.uk/news/local-news/cardiff-sees-heaviest-rainfall-uk-7592204
[47] https://www.bbc.co.uk/news/av/uk-wales-51715252
[48] https://twitter.com/nationalrailenq/status/1298125619813810177

***Heat-related events:***

- In July 2006, when temperatures reached over 30°C, the Council received a threefold increase in complaints about noisy neighbours. Air quality is a particular concern for the health of inner-city occupants during longer heat waves[45].
- A heatwave in 2018 saw Wales record the hottest June on record. 2018 was also the warmest and sunniest since 1995 and the driest since 2006[49].

***Cold weather-related events:***

- 1947: Describe as "the worst winter in the 20th century", 1947 is still the coldest February on record. Snow lasting for 7 weeks from mid-January led to the loss of half of the entire sheep population in Wales, in some places the loss was up to 75%. Factories and docks were closed across the country and people were encouraged to stay at home to keep warm (ibid).
- January 1982: Following 36 hours of non-stop snowfall, sections of South Wales were left isolated and troops were mobilised to deliver essential items and help to clear roads. In the worst hit locations, snow lay over 60cm and snow drifts were up to six metres high as a result of the fine, dry snow being blown by the wind. Cars were buried by the snow and livestock were killed as a result of being trapped in snow[50].
- February 2007: The heavy snow experienced by Cardiff is estimated to have cost city businesses £5.5 million[45].
- November 2010; Sub-zero temperatures and snowfall lead to Cardiff Council using over 20% of its salt stock in a week to grit roads. Travel infrastructure was significantly impacted, with bus services only operating on main roads and a 30mph speed limit enforced on a 65-mile section of the M4[51].
- 2018 (Beast from the East): Freezing wind and rain, blizzards and drifting snow all hit Cardiff in 2018. The severity of the weather conditions in the city led to the Met Office issuing a Red Warning, indicating a significant risk to public safety, the first time such a warning had been issued for Cardiff and South East Wales[52].

***Wind-related events:***

- In January 2007, a local school experienced £139,000 worth of roof damage due to strong winds[45].
- In February 2014, a storm with winds recorded up to 108mph left 30,000 home without power across the whole of Wales and saw fallen trees on roads and cars across Cardiff, as well as causing a street sign to fall on a man in Cardiff[5354].
- In 2017, Storm Aileen led to Cardiff Council receiving over 200 calls relating to storm damage. During the storm's peak at 2am, wind speeds of 48mph were measured. Multiple trees were blown down leading to temporary road closures[55].
- In August 2020, strong winds during Storm Francis led to multiple fallen trees in Cardiff, damaging a number of properties and businesses. Church Street in the centre of the city was closed and evacuated by police due to the damage caused to buildings by strong winds. A

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[49] https://www.bbc.co.uk/news/uk-wales-46603765
[50] https://www.walesonline.co.uk/lifestyle/nostalgia/january-snow-1982-started-snowing-14127091
[51] https://www.walesonline.co.uk/news/wales-news/snow-winter-wales-weather-cardiff-17549458
[52] https://www.cardiffnewsroom.co.uk/releases/c25/18016.html
[53] https://www.walesonline.co.uk/news/wales-news/wales-weather-23000-homes-remain-6704033
[54] https://www.walesonline.co.uk/incoming/gallery/19-dramatic-pictures-show-strength-6704244
[55] https://www.cardiffnewsroom.co.uk/releases/c25/16226.html

fallen tree on the railway line between Cardiff Central and Bridgend led to rail services being cancelled[56].

## Future Baseline

### *UKCP18 Projects*

8.3.11 UKCP18 data for the current period (2020-2039) and epoch 2080-2099 are used for the purpose of assessing potential future climate impacts within this chapter, consistent with the anticipated lifespan of the proposed development. Projections show change from the baseline period 1981-2000.

8.3.12 Representative Concentration Pathways ("RCP"s) are used within UKCP18 to capture assumptions used in a set of scenarios about future social, economic and physical changes to our environment. The conditions of each scenario are used in the process of modelling possible future climate evolution within UKCP18. RCP 4.5 and RCP 8.5 were used within this chapter and is the basis for the climate vulnerability assessment. RCP 4.5 relates most closely relates to over 2°C global warming by the end of the century, relative to the pre-industrial era, whilst RCP 8.5 relates most closely to 4°C global warming by the end of the century, relative to pre-industrial era. RCP 4.5 was chosen as the most representative emissions scenario, as it is widely believed we have already exceeded the RCP2.6 scenario commonly used. RCP 8.5 represents unmitigated climate change and is considered the most appropriate RCP to allow for the 'worse case' assessment of climate impacts on receptors.

8.3.13 UKCP18 projected climatic changes at the 50% probability level are utilised. This is the level where there is as much evidence pointing to a lower outcome as a higher one.

8.3.14 UKCP18 climate projections predict a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur, and users may need to factor this into decision-making (Met Office, UKCP18 Science Report).

### *Mean Temperatures*

8.3.15 By the end of the 21st century, all areas of the UK are projected to be warmer, more so in summer than in winter. A summary of the UKCP18 projections for mean air temperature can be seen in Table 8-6 below.

8.3.16 Hot summers are expected to become more common. In the recent past (1981- 2000) the chance of seeing a summer as hot as 2018 was low (<10%). The chance has already increased due to climate change and is now between 10-25%. With future warming, hot summers by mid-century could become even more common, near to 50% (Met Office, UKCP18 Headline Findings).

8.3.17 The UKCP18 Science Overview Report notes that, despite an overall warming trend, occurrences of cold winters should be factored into decision-making. It is for this reason that severe cold and ice is considered a potential climate hazard within the climate significance assessment presented within this chapter.

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[56] https://www.bbc.co.uk/news/uk-wales-53889484

**Table 8-6. UKCP18 Probabilistic projections of mean air temperature at the 50th percentile for RCP 4.5 and RCP 8.5**

| | Change in Mean Temperature from baseline 1981-2000 (ºC) RCP4.5 | | | Change in Mean Temperature from baseline 1981-2000 (ºC) RCP8.5 | | |
|---|---|---|---|---|---|---|
| Time period | Annual | Summer (June-Aug) | Winter (Dec-Feb) | Annual | Summer (June-Aug) | Winter (Dec-Feb) |
| 2020-2039 | 0.78 | 0.97 | 0.73 | 0.93 | 1.1 | 0.8 |
| 2040-2059 | 1.2 | 1.6 | 1.1 | 1.6 | 2.2 | 1.5 |
| 2080-2099 | 2.4 | 3.4 | 2.0 | 4.0 | 5.5 | 3.3 |

***Precipitation***

8.3.18 Rainfall patterns across the UK are not uniform and vary on seasonal and regional scales and will continue to vary in the future (Met Office, UKCP18 Headline Findings). The overall trend is an increase in rainfall in the winter and a decrease in the summer. A summary of the UKCP18 projections for mean precipitation can be seen in table 8-7 below.

8.3.19 Projections also show a trend towards increases in the precipitation intensity on wet days in winter across the whole UK and decreasing intensity in summer across central and southern UK. UKCP18 12km grid resolution modelling shows that, at the 99th percentile, daily precipitation in winter across the UK, is seen to change between the baseline period and 2061-2080 from 25.3-29.9 mm/day to 29.6-33.9 mm/day. In summer the change is from 20.9-25.8 mm/day to 17.4-26.0 mm/day. Rainfall intensity is important in understanding the risk of flood events associated with intense, shorter duration rain events.

**Table 8-7. UKCP18 Probabilistic projections of precipitation at the 50th percentile for RCP 4.5 and RCP 8.5.**

| | Change in Precipitation from baseline 1981-2000 (%) RCP4.5 | | | Change in Precipitation from baseline 1981-2000 (%) RCP8.5 | | |
|---|---|---|---|---|---|---|
| Time period | Annual | Summer (June-Aug) | Winter (Dec-Feb) | Annual | Summer (June-Aug) | Winter (Dec-Feb) |
| 2020-2039 | 0.9 | -13.0 | 6.6 | 0.8 | -14.3 | 7.6 |
| 2040-2059 | 1.8 | -19.1 | 11.1 | 1.8 | -22.8 | 14.6 |
| 2080-2099 | 3.4 | -27.9 | 19.5 | 3.6 | -42.6 | 29.6 |

### 8.3.20 Wind

8.3.21 The UKCP18 Wind Fact Sheet (Met Office, 2018) summarises a projected increase in near surface (19m height) wind speeds over the UK for the second half of the 21st century for the winter season. This is significant as the winter season is when higher wind speeds are generally experienced in the UK. This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is modest compared to interannual variability.

### 8.3.22 Sea Level Rise and Storm Surge

8.3.23 UK coastal flood risk is expected to increase across the UK under all emission scenarios, generally due to the effects of sea level rise (Met Office, 201957). UKCP18 Key Results (Met Office, 2020) provides projections for sea level rise around the UK coastline locations. Within UKCP18 data, sea level projections are given as rise in absolute level relative to the baseline period (1981-2000). Table 8-8 below provides the sea level rise projections for the site in Cardiff.

8.3.24 Storm surges are high water levels that occur due to atmospheric forcing (atmospheric pressure and winds associated with storms). As well as an increase to mean sea level, climate change is expected to change weather patterns, with an increase in the frequency and magnitude of severe weather events, including storm surge. However, there is considerable uncertainty associated with future storm surge modelling which, coupled with the negligible predicted increases, therefore it is suggested by the Met Office that no significant additional increases in extreme storm surge is expected. Additional research also shows only small changes in the size of storm surge, with the Bristol Channel and Severn Estuary expected to see only a 0.8mm/yr increase in the size of surge likely to occur once every 50 year[58].

**Table 8-8. Probabilistic projections of mean sea level rise at the 50th percentile for RCP 4.5 and RCP 8.5 for the site in Cardiff.**

| Time period | Mean sea level rise from baseline 1981-2000 (m) RCP4.5 | Mean sea level rise from baseline 1981-2000 (m) RCP8.5 |
|---|---|---|
| 2020-2039 | 0.13 | 0.15 |
| 2040-2059 | 0.24 | 0.28 |
| 2080-2099 | 0.47 | 0.65 |

#### Climate Drivers and Hazards

Following a review of the data sources outlined above, the pertinent climate drivers for the site and the associated climate hazards have been identified.

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[57] https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf
[58] http://www.coastaladaptation.eu/index.php/en/9-experiences-3/severn-estuary/138-climate-change-and-coastal-management#:~:text=Within%20the%20Bristol%20Channel%20and,to%20projected%20sea%20level%20rise.management#

| Climate Drivers | Climate Hazard |
|---|---|
| Increase in average temperature and extreme high temperature | Heatwaves and overheating |
| Decreased summer rainfall | Drought |
| Increase in intensity of precipitation (summer and winter) | Heavy rainfall (and consequent damages to buildings, infrastructure etc.) |
| | Flooding (pluvial and fluvial) |
| Increase in precipitation (summer and winter) | Flooding (pluvial and fluvial) |
| Sea level rise | Flooding (coastal) and coastal erosion |
| Increased storms and high winds | Storms and storm surge |
| Cold weather, snow | Severe cold, ice and snow |

### Sensitive Receptors

8.3.25 To assess the potential impact of climate hazards on the proposed development, both construction and operational receptors have been considered. For construction, the climate hazards have each been assessed for their potential impact on construction works. To assess the impact of climate hazards on operational aspects of the proposed development, the following receptors have been considered:

- Flood defence assets (sheet piles and rock armour)
- Flood defence assets (embankment)
- Soft engineering (e.g. Brushwood)
- Operational and maintenance activities

8.3.26 In addition to assessing the climate resilience of the proposed development itself, it is important to understand how the proposed development may impact upon the climate resilience capacity of receptors which transect the site boundary (e.g. utilities and transport infrastructure), local residents and ecological receptors.

#### *Interdependencies and Infrastructure*

8.3.27 The proposed development is located in a heavily urban area - the East of Cardiff Docks Significant critical transport, waste management, energy infrastructure, and residential and commercial infrastructure is located around the site, including:

- The Lamby Way Landfill site.
- The 'Frag tip' (an area of reclaimed land forming the coastline of the Severn Estuary).
- Extensive areas of Made Ground used for industrial and recreational purposes.
- Utilities infrastructure.
- Tremorfa Industrial Estate (metal salvage works, recycling yards, vehicle repairs).
- Celsa Steelworks.
- Lamby Way and Rover Way are key transport routes for traffic accessing Cardiff Docks, Cardiff City Centre and South East Cardiff; and,

- An electricity substation thought to supply DCWW Wastewater Treatment Works located to the west of the site.

***Local residents***

8.3.28 The land to the east of the site is comprised of a mix of green space, residential properties, and local amenities including schools, leisure facilities and a large supermarket. Two allotment sites can be found on the Western Bank of the Rhymney River in the North of the site. In addition, a Travellers site is located directly off Rover Way between the road and the Coastline.

8.3.29 The Rhymney River supports a wide range of recreational activities, including the Rhymney River Motor Boat, Sail and Angling Club on the West Bank of the River. Other users include Glamorgan Angling Club, Cardiff Sea Cadets, Cardiff Canoe Club and bird watchers. Additionally, the Wales Coast Path follows the coastline through the proposed development.

***Natural Environment***

8.3.30 The proposed development sits within the Severn Estuary, adjacent to the River Rhymney and Cardiff Flats. The site is located within the Severn Estuary European Marine Site (EMS), which is designated for a range of coastal habitats and species such as intertidal and subtidal mudflats, saltmarsh, fish, and overwintering birds. The Severn Estuary is also designated as a SSSI, SPA, SAC and Ramsar site. The Rhymney River is designated as an SINC.

## 8.4 Potential Impacts and Significant Effects

8.4.1 In order to assess the scale of likely impact of the climate hazards identified on the proposed development, a vulnerability potential effects assessment has been completed. For the purposes of this EIA, it is an assessment of the likely potential effects.

8.4.2 This assessment is comprised of both an exposure assessment, which considers the site's exposure to each climate hazard both now and by the late century, (2080-2099) and a consequence assessment, which determines the level of impact each climate hazard could have on the project receptors.

8.4.3 Within each assessment, the exposure to climate hazards (both now and mid-century) and consequences will be given a score. These scores will then be multiplied to provide an overall vulnerability score for each receptor to each climate hazard both now and in the future. This score is then used to determine the significance level of the potential effect in accordance with the EIA Regulations.

8.4.4 Following the scoring, a more detailed assessment of those hazards and receptors that were identified as high risk (a vulnerability score of 6+, i.e. with a significance level of substantial) has been completed.

8.4.5 The preference would be to undertake an assessment that relates to the full design life of the proposed scheme (to 2119), using relevant climate change projections data, however climate projections beyond 2100 are very uncertain.

### Consideration of local receptors

8.4.6 Local sensitive receptors include key infrastructure, residential areas and sites of ecological importance located close to the site. These are identified in the section above, and more detail on these can be seen in section 1.2 of this Environmental Statement. Within EIA methodology, Climate Resilience should consider the impact of predicted climate change conditions on the proposed development for which the EIA is being undertaken. In this sense Climate Resilience differs from other environmental considerations within the EIA. Local receptors are considered within EIA climate resilience where the proposed development could impact on the ability of these receptors to adapt and demonstrate resilience to climate change. For example, where the proposed development results in an increase in the intensity of fluvial flooding to nearby residential settlements. It is the author's professional opinion that the development, proposed as it is in outline design detail, will not impact on the ability of the identified local receptors to adapt and demonstrate resilience to future climate change.

### Embedded Adaptation

8.4.7 As the proposed development is a Flooding and Coastal Erosion Risk Management (FCERM) scheme, it is inherently a form of adaptation, namely flood and erosion mitigation. In terms of mitigating the potential effects of climate change upon the proposed development, this will be addressed to an extent through the design process by using climate projections to ascertain the level of protection required. The proposed development aims to reduce and manage the coastal flood risk to people and assets for the next 100 years, taking into account predicted future climate change up to 2119.

### Exposure Assessment

8.4.8 The first stage in determining Significance of Effect to climate hazards is to determine the degree to which the location of project is likely to be impacted by climate hazards. This stage disregards proposed site use (during construction or operation) and considers likelihood of exposure based solely on-site location.

8.4.9 Exposure is scored in accordance with the methodology established in section 8.3.1. Current exposure (now- applicable to construction stage of the development) and exposure in 2080-2099 (representing the later stages of the development life) are scored. The exposure assessment can be seen in Table 8-9 below.

**Table 8-9. Exposure Assessment of the climate hazards relevant to the proposed development.**

| Climate Variable | Justification | Exposure now (construction) | Exposure 2080-2099 (operation) |
|---|---|---|---|
| Heatwaves and overheating | **Now (2020-2039)**: Wales recently recorded the hottest June on record in 2018.<br>**Future**: Higher temperatures in the summer and the frequency of heatwave events are likely to increase (UKCP18, | 3 | 3 |

| Climate Variable | Justification | Exposure now (construction) | Exposure 2080-2099 (operation) |
|---|---|---|---|
| | 2019) | | |
| Drought | **Now**: 2018 was recorded as the driest June in Wales since 2006.<br>**Future**: Drought events are likely to increase as a result of hotter, drier summers (UKCP18, 2019). | 2 | 3 |
| Heavy rainfall (and consequent damage to buildings etc.) | **Now**: Heavy rainfall events have occurred many times in the past and can sometimes have significant consequences. In 2020, at least 3 storms brought heavy rainfall.<br>**Future**: More frequent heavy/intense rainfall events are likely (UKCP18, 2019). | 3 | 3 |
| Flooding (Pluvial and Fluvial) | **Now**: Flood events have previously occurred on several occasions in the past. Flooding was caused by 3 separate storm events in 2020.<br>**Future**: An increase in intense rainfall events likely to increase the risk of pluvial flooding (UKCP18, 2019). | 3 | 3 |
| Flooding (Coastal) | **Now**:<br>**Future**: Sea level rise is likely to increase the coastal flood risk (UKCP18, 2019). | 3 | 3 |
| Storms (including storm surge) | **Now**: In 2020, at least 3 storms brought heavy rainfall.<br>**Future**: | 3 | 3 |
| Severe cold, ice and snow | **Now**: South Wales has historically experienced several severe cold and snow events within the past 50 years.<br>**Future**: It is not expected that severe cold, ice and snow will increase under climate change. There is a degree of uncertainty surrounding this which is recognised within UKCP18. | 2 | 2 |

## 8.5 Consequence Assessment

### During Construction

8.5.1 Based on completion of construction of the development within ~5 years, current climatic conditions will prevail and are consistent with the current exposure (Exposure Now) as identified in the table above.

8.5.2 Table 8-10 below assesses the consequence to the construction stage of development of exposure to the climate variables hazards identified.

### Table 8-10. Consequence assessment of the construction phase of the proposed development

| Climate Hazard | Consequence (Construction of Proposed Development) |
|---|---|
| **Heatwaves and overheating** | 2 |
| Justification | Risk to construction worker health and safety (e.g. heat stress, dehydration, general thermal discomfort). Potential to reduce productivity and cause delay to construction programme.<br>Threshold temperatures for materials and equipment on site could be breached resulting in programme delays with associated financial implications. |
| **Drought** | 2 |
| Justification | Potential for disruption to the mains water supply required for construction work, or limits placed on how much water can be used, which could prevent necessary construction works and impact programme, resulting in financial losses. |
| **Heavy rainfall (and consequent damage to buildings, etc.)** | 3 |
| Justification | Heavy rainfall events could lead to flooding of surrounding road networks and limit access to the site, preventing workers, equipment and materials from accessing/leaving the site.<br>Risk to construction workers from damage to infrastructure and construction site as a result of heavy rain.<br>Risk of subsidence (caused by waterlogging) of ground workings poses risk to construction workforce.<br>Increased insurance costs and excesses. |
| **Flooding (Pluvial, Fluvial)** | 3 |
| Justification | Flooding of the construction site and access roads could prevent access to the site, impacting on the flow of personnel, materials and equipment. Associated impact on productivity, programme resulting in financial implications.<br>Damage to infrastructure and equipment stored below flood level.<br>Potential risk of injury to workers from infrastructure damage.<br>Increased insurance costs and excesses. |
| **Flooding (Coastal)** | 3 |
| Justification | Flooding of the construction site and access roads could prevent access to the site, impacting on the flow of personnel, materials and equipment. Associated impact on productivity, programme resulting in financial implications.<br>Damage to infrastructure and equipment stored below flood level.<br>Potential risk of injury to workers from infrastructure damage.<br>Increased insurance costs and excesses. |
| **Storms (including storm surge)** | 3 |
| Justification | Strong winds could stop construction work or damage partially constructed buildings and infrastructure.<br>Risk to workforce from operating machinery and construction tasks at height/in exposed areas during high winds.<br>Risk to workers from flying debris and infrastructure damage.<br>Flooding resulting from storms/storm surge prevent access to the site (access roads blocked), impacting on the flow of personnel, materials and equipment.<br>Associated impact on productivity, programme resulting in financial implications.<br>Increased insurance costs and excesses. |
| **Severe cold / ice / snow** | 3 |
| Justification | Risk of injury to workers due to hazardous icy conditions.<br>Disruption to surrounding transport infrastructure from snow and ice could limit access to the site for both workers and material deliveries. Impact on productivity, construction timescales with associated financial implications. |

### Significance assessment

8.5.3 The scores from the exposure and consequence assessments for the construction phase are combined to determine the significance of effect in accordance with the scoring methodology defined in Section 8.3.1. The results are presented in Table 8-11 below.

**Table 8-11. Significance assessment of the impact of climate hazards on the construction of the proposed development.**

| Climate Hazard | Now (Construction) |
|---|---|
| Heatwaves and overheating | 6 |
| Drought | 4 |
| Heavy rainfall (and consequent damage to buildings, etc.) | 9 |
| Flooding (Pluvial and Fluvial) | 9 |
| Flooding (Coastal) | 9 |
| Storms (including storm surge) | 9 |
| Severe cold / ice / snow | 6 |

### Summary of significant effects during construction

8.5.4 Impacts that have been given Substantial Adverse (red) scores for one or more receptors (as a product of multiplying the Exposure and Consequence scores) are summarised below.

| Climate Variable | Description of risk and social, economic and environmental impacts |
|---|---|
| **Heatwaves and overheating** | *Heatwaves could pose a health and safety risk to site personnel working on the site, causing potential overheating and associated health risks.* |
| **Drought** | *Potential risk through disruption to water supplies to the site. This could result in delays to construction and a potential health and safety risk to site personnel.* |
| **Heavy rainfall (and consequent damage to buildings, etc.)** | *Heavy rainfall poses a risk to both site personnel and infrastructure on the site. Constructions materials could become damaged, which would potentially delay the programme and have financial implications of obtaining additional materials.* |
| **Flooding (Pluvial and Fluvial)** | *Predicted flood extents up to a 0.5% AEP event show the current flood risk (2019) shows potential flood risk areas across the proposed site. If a flood event were to occur during construction, this could put site personnel and construction operations at risk. Flooding of access routes along the surrounding road network could also pose a risk to construction works.* |
| **Flooding (Coastal)** | *Predicted flood extents up to a 0.5% AEP event show the current flood risk (2019) shows potential flood risk areas across the proposed site. If a flood event were to occur during construction, this could put site personnel and construction operations at risk. Flooding of access routes along the surrounding road network could also pose a risk to construction works.* |
| **Storms (including Storm Surge)** | *Adverse weather and storm conditions, including heavy rainfall and high winds, poses a health and safety risk to those working on the site. There is a potential risk of infrastructure damage, flying debris and damage to plant* |

| | |
|---|---|
| | *or construction materials as a result of strong winds or heavy rainfall. Storm surge could cause damage to the construction site, pose a risk to site personnel, and reduce access to the site if the surrounding road network is flooded.* |
| **Severe cold / ice / snow** | *Severe cold/ice/snow conditions could pose a health and safety risk to site personnel. There may potentially be some adverse impacts to construction materials being stored on site, which could cause delays to the construction programme.* |

### During Operation

8.5.5 The potential impacts the climate hazards identified are likely to have on during operation of the proposed development are presented in Table 8-12 below. A series of development receptors have been identified, and each are assessed against the climate hazards, and given a scored based on the methodology presented in Section 8.3.1.

**Table 8-12. Consequence assessment of the impacts of the climate hazards on the operation of the proposed development.**

| | **Development receptors** | | | | |
|---|---|---|---|---|---|
| | Flood defence assets (sheet piles & rock armour) | Flood defence assets (embankment) | Soft engineering | Operational and maintenance activities | Interdependencies (infrastructure, local residents, natural environment) |
| **Heatwaves and overheating** | 0 | 1 | 0 | 2 | 0 |
| Justification | No impact likely | Increased pedestrian footfall (e.g. along Wales Coastal Path) during hot weather could lead to increased erosion of embankment | No impact likely | Increased pedestrian footfall (e.g. along Wales Coast Path) during hot weather could lead to increased requirement for patch repairs<br><br>Risk of impacts on ability of workers to carry out maintenance and operational activities. Potential health risks associated with exposure to heat. Risk to activities being carried out at all or effectively. | No impact likely |
| **Drought** | 0 | 2 | 0 | 1 | 0 |
| Justification | No impact likely | Risk to vegetation on earth embankments which could compromise the structure's resistance to due to soil instability | No impact likely | Reduced requirement for vegetation management due to poor growth. | No impact likely |
| **Heavy rainfall (and consequent damage to infrastructure** | 0 | 2 | 0 | 2 | 0 |

| | Development receptors | | | | |
|---|---|---|---|---|---|
| | Flood defence assets (sheet piles & rock armour) | Flood defence assets (embankment) | Soft engineering | Operational and maintenance activities | Interdependencies (infrastructure, local residents, natural environment) |
| **, etc.)** | | | | | |
| Justification | No impact likely | Risk of increased soil erosion on embankments (even greater risk following drought conditions) | No impact likely | Risk of impacts on ability of workers to carry out maintenance and operational activities. Compromises quality and frequency of maintenance and operational activities.<br><br>Increased requirement for patch repairs due to impact of soil erosion to embankments. | No impact likely |
| **Flooding (Pluvial, Fluvial)** | 2 | 2 | 3 | 2 | 0 |
| Justification | Risk of damage to food defence assets during a storm event.<br><br>Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of damage to embankments following overtopping of defences as a result of storm event that exceeds AEP design life.<br><br>Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of damage to soft engineering assets following storm events.<br><br>Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of impacts on ability of workers to carry out maintenance and operational activities. Compromises quality and frequency of maintenance and operational activities. | Positive impacts of flood risk reduction in the local area as a result of the proposed development. |
| **Flooding (sea level rise)** | 2 | 2 | 3 | 2 | 0 |
| Justification | Reduction in design life of flood defence assets if sea level rise exceeds proposed design life.<br><br>Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of damage to embankments following overtopping of defences as a result of storm event that exceeds AEP design life. Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of damage to soft engineering assets following storm events.<br><br>Largely positive impacts of the flood defence assets protecting surrounding areas from flooding. | Risk of impacts on ability of workers to carry out maintenance and operational activities. Compromises quality and frequency of maintenance and operational activities. | Positive impacts of flood risk reduction in the local area as a result of the proposed development. |

| | Development receptors | | | | |
|---|---|---|---|---|---|
| | Flood defence assets (sheet piles & rock armour) | Flood defence assets (embankment) | Soft engineering | Operational and maintenance activities | Interdependencies (infrastructure, local residents, natural environment) |
| **Storms (including storm surge)** | 2 | 2 | 3 | 2 | 0 |
| Justification | Risk of damage to assets due to the combination of high winds and heavy rain. | Risk of damage to/ erosion of the embankment due to the combination of high winds and heavy rain | Risk of damage to soft engineering as a result of high winds and heavy rain. | Risk of impacts on ability of workers to carry out maintenance and operational activities. Compromises quality and frequency of maintenance and operational activities.<br><br>Increased requirement for patch repairs due to impact of soil erosion to embankments. | No impact likely |
| **Severe cold / ice / snow** | 0 | 0 | 0 | 0 | 0 |
| Justification | No impact likely | No impact likely | No impact likely | No impact likely | No impact likely |

### Interdependent receptors

***Infrastructure and Local residents***

8.5.6 The construction of new flood defences coupled with the raising of existing embankments could result in a false sense of security amongst residents as well as those who have interests in using the land behind the defences such as planners and developers. This could in turn lead to unsuitable and unsustainable development taking place behind the defences, increasing the number of potential receptors to future increases in flood and erosion risk. However, as a flood risk assessment will be needed for any planning applications nearby, this risk should be limited. There is an additional risk of flood waters being trapped behind raised flood defences if overtopped during significant storm event, increasing risk and duration of flooding to local receptors.

8.5.7 However, generally the scheme is likely to have a largely positive impact on local residents and surrounding infrastructure by providing additional protection from the risk of flooding.

***Natural Environment***

8.5.8 The scheme is predicted to lead to a loss of intertidal habitat and increased coastal squeeze. Research[59] suggests that the loss of any component of an ecosystem (particularly in a coastal context) can have "important and long-last repercussion for other components of the ecosystem" such as their ability to respond to multiple climate stressors. This is considered further in chapter 5.

[59] https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/1365-2745.12799

### Significance assessment

8.5.9 The scores from the exposure and consequence assessments for the Operation phase are combined to determine the significance of effect in accordance with the scoring methodology defined in Section 8.3.1. The results are presented in Table 8-13 below.

**Table 8-13. Significance assessment of the impacts of climate hazards on the proposed development.**

| Climate Hazard | Flood defence assets (sheet piles & rock armour) | | Flood defence assets (embankment) | | Soft engineering | | Operational and maintenance activities | | Interdependencies | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Now | Future | Now | Future | Now | Future | Now | Future | Now | Future |
| Heatwaves and overheating | 0 | 0 | 3 | 3 | 0 | 0 | 6 | 6 | 0 | 0 |
| Drought | 2 | 0 | 4 | 6 | 0 | 0 | 2 | 3 | 0 | 0 |
| Heavy rainfall (and consequent damage to buildings, etc.) | 0 | 0 | 6 | 6 | 0 | 0 | 6 | 6 | 0 | 0 |
| Flooding (Pluvial and Fluvial) | 6 | 6 | 6 | 6 | 9 | 9 | 6 | 6 | 0 | 0 |
| Flooding (Coastal) | 6 | 6 | 6 | 6 | 9 | 9 | 6 | 6 | 0 | 0 |
| Storms (including storm surge) | 6 | 6 | 6 | 6 | 9 | 9 | 6 | 6 | 0 | 0 |
| Severe cold / ice / snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### Summary of significant effects during operation

8.5.10 Impacts that have been given Substantial Adverse (red) scores for one or more receptors (as a product of multiplying the Exposure and Consequence scores) are summarised below.

| Climate Variable | Description of risk and social, economic and environmental impacts |
|---|---|
| **Heatwaves and overheating** | ***Significant impacts: Operational and maintenance activities (Now and Future)***<br><br>*Potentially some significant impacts to operational and maintenance activities from heatwaves and overheating. Extreme heat could affect site personnel carrying out inspections.* |
| **Drought** | ***Significant impacts: Flood defence assets (embankment) (Now and Future)***<br><br>*Potentially some significant impacts to the flood embankments as a result of drought. Any impacts to vegetation as a result of drought could affect the stability of the embankment or result in some soil erosion, which could impact the structural integrity of the embankments.* |
| **Heavy rainfall (and consequent damage to buildings, etc.)** | ***Significant impacts: Flood defence assets (embankment) and Operational and maintenance activities (Now and Future)***<br><br>*There is potentially some risk to the embankments due to a risk of soil erosion resulting from heavy rainfall events. This risk could be increased if the heavy rainfall occurs following drought conditions. There is potential for additional health and safety risks to site personnel carrying out inspections and maintenance work.* |

| Climate Variable | Description of risk and social, economic and environmental impacts |
|---|---|
| **Flooding (Pluvial and Fluvial)** | ***Significant impacts: Flood defence assets (sheet piles & rock armour), Flood defence assets (embankment), Soft engineering and Operational and maintenance activities (Now and Future)***<br><br>*There is a significant risk of damage to the flood risk assets, and additional risk to soft engineered assets following storm events. Any overtopping of the assets has the potential to cause some damage, and soft engineered assets are likely to be at a more significant risk of being damaged/destroyed or washed away. There is an additional health and safety risk to site personnel completing maintenance or needing to complete repair works.* |
| **Flooding (Coastal)** | ***Significant impacts: Flood defence assets (sheet piles & rock armour), Flood defence assets (embankment), Soft engineering and Operational and maintenance activities (Now and Future)***<br><br>*There is a significant risk of damage to the flood risk assets, and additional risk to soft engineered assets following storm events. Any overtopping of the assets has the potential to cause some damage, and soft engineered assets are likely to be at a more significant risk of being damaged/destroyed or washed away. There is an additional health and safety risk to site personnel completing maintenance, limits to the ability to carry out works, and additional needs to complete repair works.* |
| **Storms (including Storm Surge)** | ***Significant impacts: Flood defence assets (sheet piles & rock armour), Flood defence assets (embankment), Soft engineering and Operational and maintenance activities (Now and Future)***<br><br>*There is a significant risk of damage to flood risk assets and soft engineered assets due to storm events. Strong winds are likely to have less sever impacts; however, storm surge could cause the flood defences and embankment to overtop, causing damage to the assets. There is an additional health and safety risk to site personnel completing maintenance, limits to the ability to carry out works, and additional needs to complete repair works.* |
| **Severe cold / ice / snow** | *No significant impacts* |

## 8.6 Adaptation and Monitoring

8.6.1 This section proposes adaptation measures for Substantial Adverse impacts. In the table below, potential mitigation measures for these receptors to each climate variables have been identified.

### During Construction

8.6.2 During the construction phase of the proposed development, the following adaptation measures are proposed.

**Table 8-14. Proposed adaptation measures to significant climate hazards during construction**

| Climate hazard | Proposed adaptation Measures |
|---|---|
| Heatwaves and overheating<br>Drought<br>Heavy rainfall (and consequent damage to buildings, etc.)<br>Flooding (pluvial and fluvial)<br>Flooding (coastal)<br>Storms (including storm surges)<br>Severe cold / ice / snow | The contractor will develop a climate emergency plan and procedure. All site staff will be briefed on protocol for a climate emergency on site. The emergency plan will include, but not be limited to, the following:<br>1. Emergency procedures for flooding and storm events, including threshold for cessation of work caused by a climate event. Detail of warning systems and communication channels.<br>2. Site layout plan indicating areas safe access, egress and muster points in the event of a major flood or storm event during site operation.<br>3. Details of alternative road access to the site should the principal routes be blocked.<br>4. Use of the NRW Flood Risk Warning Service to provide early warning of flood risk to the construction site and allow preparedness, reducing exposure of site personnel to risks.<br>5. Contingency plans and accident plans.<br>6. Staff training in safe working during climate events (flood and storm events).<br><br>Method statements and risk assessments for all site activities to include risks from flooding and storms, including secondary impacts such as landslips and groundwork collapse due to water logging. The Construction (Design and Management) Regulations (CDM Regulations) 2015 require that as the design of a development progresses, risks are identified and eliminated, and residual risks are reduced and managed. Risk assessments and method statements (RAMS) are an effective means of assessing, managing and controlling the health and safety risks associated with storms and adverse weather. The method statement should consider how controls put in place will work in adverse conditions. |

### During Operation

8.6.3 The mitigation opportunities for operational risks from climate change are similar to those listed in the construction table above. A climate emergency plan and procedure will need to be developed by the operator that includes a plan and risk assessment for each of the potential climate hazards that could impact the operation of the asset, as listed in Table 8-14

8.6.4 Additional mitigation measures that may be relevant to the operation includes the development of a detailed monitoring regime for the flood defence. Included as part of this would likely be:

- Ensuring a full inspection of the assets is completed following any storm event/adverse weather, checking for any damage to the assets.
- Repairing any damage found on the assets as quickly as possible to minimise any adverse effects resulting from additional adverse weather.

### Residual Effects

8.6.5 With the proposed adaptation measures in place, a small number of risks remain as a result of climate change impacts. These residual risks for construction include:

- The risk of flooding (pluvial, fluvial and coastal) of the construction site and surrounding areas remains high as works to complete the flood defences is completed.

The risk assessment completed should outline a plan for removal of materials, plant and personnel from the site should a risk of flooding be imminent. Also safe access for beach and tidal working.

8.6.6 During operation, the residual risks include:

- Storms and adverse weather conditions remain a risk to the flood risk assets, particularly the soft engineered assets. Damage to the assets may occur as a result of flood events/storm events.

### Summary

8.6.7 The primary impacts of climate change in respect of the proposed development, are likely to be risk of heatwaves, heavy rainfall, flooding (pluvial and coastal) and storm events during both construction and operation. During construction, climate hazards pose a health and safety risk to site personnel, as well as risk damage to materials and plant on the site. During operation, the key risks are damage to the flood risk assets, either through storm/flood events, or as a result of erosion from drought conditions and heavy rain.

8.6.8 The scheme will have a large positive impact on the receptors identified providing improved resilience to flooding to the surrounding area.

8.6.9 The proposed scheme is itself a response to the consequences of climate change. Climate change is resulting in more extreme weather phenomena and will continue to cause flood events to be more frequent, more severe and less predictable. The potential impact climate change will have upon storminess could further exacerbate these issues. The scheme has been designed to incorporate climate change allowances and therefore adapts to future climate change. Due to this, the adaptation options for this scheme are limited.

## 8.7 Greenhouse Gas Assessment

8.7.1 This second part of the climate change chapter is concerned with GHG emissions, namely the greenhouse gas emissions resulting from the proposed development over its lifetime compared against baseline and alternative emission scenarios and a consideration of climate change mitigation opportunities.

### Assessment Methodology

8.7.2 The GHG assessment uses the Environment Agency's e:Mission Carbon Planning Tool. This program predicts the GHG impacts of construction activities in terms of CO2e. It does this by calculating the embodied CO2e of materials plus the CO2e associated with their transportation. It also considers personnel travel, site energy use and waste management. The tool was developed by the EA, initially for use on its projects that are predominantly fluvial and coastal schemes[60]

8.7.3 The tool calculates carbon emissions associated with construction and operation across the whole lifecycle of the asset, which is assumed in the tool to be 100 years. The carbon calculated is broken down into:

[60] Environment Agency, 2016. e:Mission Carbon Planning Tool [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/571707/LIT_7067.pdf

- Capital carbon: the carbon associated with the construction or refurbishment of an asset
- Operational carbon: the carbon associated with the ongoing operation of an asset
- Replacement carbon: the carbon associated with the re-building of an asset at the end of its useful (or refurbished) life
- Refurbishment carbon: the carbon associated with interventions required at the end of an asset's life to extend the useful life
- Demolition carbon: the carbon associated with any demolition works that will be required at the end of an asset's useful life
- Residual carbon: the carbon emissions associated with assets that extend beyond the 100-year project lifespan

8.7.4 Where information was not available to complete the climate change calculations, assumptions were made that detail a worst-case scenario (following the guidelines of the precautionary principle). Assumptions are stated below:

- The Environment Agency's e: Mission Carbon Planning Tool assumes that transporting material by road emits GHGs at a rate of 0.10672kgCO2e km-1kg-1;
- Plant usage during the construction phase has been assumed based on a comparative project.
- When determining the distance travelled for materials, it was assumed the majority would come from a regional location, with only national or local listed if this was explicitly known.

8.7.5 Operational GHG emissions of the proposed development are not considered significant. Although there would be emissions associated with maintenance (i.e. patch repair usage of concrete), these would be difficult to quantify and would be likely to be negligible in comparison to construction GHG emissions. Despite this, operational emissions are calculated as part of the Environment Agency Carbon Planning tool, therefore the following assumption has been made:

- Operational emissions are based on the assumption there will be one visit a year to inspect the assets, travelling a 15km round trip in a van, with low plant requirement (based on consultation with Cardiff Council).

8.7.6 There could be significant future GHG emissions associated with adapting the proposals beyond the design life. The impacts of refurbishment, replacement and demolition of any assets part of the proposed development are also calculated within the carbon planning tool, based on inputs to/assumptions made by the tool.

### Baseline emissions

8.7.7 The baseline for the Proposed Development is defined as the current GHG emissions arising from FCERM activities and infrastructure within the Project Site boundary, in line with the IEMA (2017) guidance.

8.7.8 The project site contains a number of different land uses, including capped landfill sites, residential homes, highways, commercial units, leisure facilities, medical centre, car parks, allotments, woodland and industrial estates. However, the GHG emissions from aspects outside of specific FCERM activities are unlikely to change or be impacted by the proposed development, therefore these are not considered in this assessment.

8.7.9 It is difficult to determine the baseline GHG emissions of the existing FCERM assets in the area because the existing flood defence infrastructure comprises embankments which have very low operational GHG emissions and across the rest of the area where new flood defence assets are proposed, there are no existing assets that emit GHGs.

### Alternative emissions

8.7.10 In the context of this Proposed Development (flood risk mitigation) an important baseline to consider is the alternative future baseline emissions as a result of the Proposed Development not being constructed.

8.7.11 The GHG emissions associated with flood and coastal erosion damages as a result of not constructing flood defences are potentially significant in the short term. These could include emissions from:

- Building repairs
- Replacement of contents of properties
- Construction of replacement infrastructure and buildings

8.7.12 A report from the Environment Agency in 2010 estimated that the annual carbon emissions arising from FCERM activities (delivering of traditional flood defences) were 0.53 Mt CO2e per year, whereas flood and coastal erosion damages were estimated to be 1.90 Mt CO2e per. These figures were calculated using a proxy approach, linking estimates of economic damage costs to carbon emissions, using a multiplier similar to that calculated for TE2100 (Halcrow, 2008). The report concluded that net emissions would be greater without FCERM activities due to the impacts of greater flood damage.

### GHG emissions from construction

8.7.13 It is expected that the majority of GHG emissions from the proposed development will occur in the construction phase. Due to the combination of the 100-year design life of the scheme, no requirement for energy use to function, alongside limited maintenance requirements, operational emissions are likely to be limited.

8.7.14 The carbon emissions likely to result from the proposed scheme, calculated in the Carbon planning tool are presented in Table 8-15 below.

**Table 8-15. Carbon emissions resulting from each stage of the proposed development**

| **Stage of project** | **Carbon emissions (t CO2e)** |
|---|---|
| Capital carbon | 16,431.06 |
| Operational carbon | 153.45 |
| Replacement carbon | 860.12 |
| Refurbishment carbon | 1422.59 |
| Demolition carbon | 100.22 |
| Residual carbon | 0 |
| **Whole Life carbon (*total of the above*)** | **18,967.44** |

8.7.15 It is clear from the calculations that capital carbon resulting from construction is the biggest contribution to whole life carbon, as expected. Smaller amounts of CO2e are likely to arise from operation of the proposed development, based on yearly inspection of the assets. Further emissions are also likely to arise from any replacement, refurbishment, and demolition of assets, based on the lifespan of each material as assumed by the calculator.

### Carbon mitigation potential

8.7.16 Despite the potential high carbon emissions resulting from the construction of the proposed development, there are a variety of opportunities to reduce the impact.

#### *Alternative materials*

8.7.17 The cement and concrete industry is a significant contributor to climate change, accounting for between 5 and 6% of global emissions61. The mining and quarrying industry is also a significant contributor to UK carbon emissions, with GHG emissions totalling 22,226t CO2e in 201962. Rock armour for sea defences is usually limestone, granite or concrete, due to those materials' hardness and durability. Limestone is the most common rock armour material and has a relatively low embodied carbon value in comparison with other quarried rock types63.

8.7.18 Alternative options to the construction materials proposed should be considered to improve the GHG impact the proposed development will have. Opportunities to use low carbon concrete should be explored in particular, as concrete is used in both the scour protection and capping beams as part of the current designs.

#### *Low carbon fleet/plant*

8.7.19 As part of the construction of the proposed development, plant usage is likely to contribute a significant part of the carbon emissions. To reduce the impact of carbon emissions from plant, options such as hybrid or electric plant, or the use of biofuels should be considered.

#### *Carbon sequestration*

8.7.20 Whilst not a direct form of reducing carbon emissions, it is possible the surrounding land use may provide some carbon sequestration benefits. The key habitats likely to provide any significant carbon sequestration benefits are woodland/trees, along with intertidal mudflat and saltmarsh.

8.7.21 A small area of broadleaved trees close to the roundabout could sequester carbon. The area is approx. 0.16ha, which using a carbon sequestration rate of 10.71t CO2e/ha/yr64 could sequester up to 1.71t CO2e per year. Additional sequestration benefits could be provided through any saltmarsh enhanced through the proposed development.

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61 https://unfccc.int/news/bigger-climate-action-emerging-in-cement-industry
62 https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/k8ar/bb
63 https://greenbuildingencyclopaedia.uk/wp-content/uploads/2014/07/Full-BSRIA-ICE-guide.pdf
64 https://www.rspb.org.uk/globalassets/downloads/documents/positions/economics/annexes-to-accounting-for-nature---a-natural-capital-account-for-the-rspbs-estate-in-england.pdf

# 9 Cumulative Effects

## 9.1 Introduction

9.1.1 Regulation 17(3) and 4(2) of the EIA Regulations requires with reference to paragraph 5 of Schedule 4, that a consideration of cumulative effects is included in the Environmental Statement:

*9.1.2 'A description of the likely significant effects of the development on the environment resulting from…(e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources…*

*9.1.3 The description of the likely significant effects on the factors specified in regulation 4(2) should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development…'*

9.1.4 Cumulative effects are therefore assessed with regard to (i) the environmental impacts of the development proposals when considered cumulatively with the environmental impact of other existing adjacent and approved development projects at the time of submission of the ES; and (ii) the cumulative effect of inter-relationships between multiple environmental impacts on individual receptors.

## 9.2 Baseline Conditions

9.2.1 A search of Cardiff Council planning applications identified developments which may cause cumulative effects65. Development projects that meet the above criteria, during the scoping stage, were identified as:

- 20/01279/MJR | renewal of 17/02130/MJR for the removal of fill material and the construction of a biomass power plant (up to 9.5mw) and a maximum of 130,000 sq. ft. of industrial accommodation (B8 use class), new access roads and associated landscaping works | land at Rover Way, Pengam
- 19/00397/MJR – On land at Lamby Way Landfill Site, Lamby Way, Wentlooog, Cardiff, CF3 2HP for the installation of a ground mounted Photovoltaic Solar Farm and ancillary development – Granted on 16th May 2019

## 9.3 Assessment Methodology and Significance Criteria

9.3.1 As noted above cumulative effects are assessed with regard to (i) the environmental impacts of the development proposals when considered cumulatively with the environmental impact of other existing adjacent and approved development projects at the time of submission of the ES; and (ii) the cumulative effect of inter-relationships between multiple environmental impacts on individual receptors.

9.3.2 Regarding (i), the spatial and temporal scope of the EIA would take into account the following:

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65 https://www.cardiff.gov.uk/ENG/resident/Planning/View-and-track-planning-applications/Pages/View-and-track-any-planning-applications.aspx

- the physical extent of the proposed works, as defined by the limits of land to be used (temporarily or permanently) as denoted in the respective planning or marine licence consents by their site boundary;
- the nature of the existing baseline environment, including the location of sensitive receptors;
- the geographical extent of impacts beyond the sites, e.g. effects from traffic, visual effects and disturbance of ecological receptors;
- the geographical boundaries of the political and administrative institutions and authorities, which provide the planning and policy context for the project; and
- the timing of the works for the respective development projects.

9.3.3 Cumulative effects would therefore consider the impacts of any other committed developments where these would coincide with both the temporal and spatial scope of the development proposals assessed within this ES. The environmental impacts of the respective development projects are assessed collectively on individual receptors to determine where this could give rise to synergistic likely significant effects.

9.3.4 Regarding (2) the cumulative effect of inter-relationships between multiple environmental impacts would consider any impacts assessed individually within this ES, the synergistic effect of which would either be made greater as a result of the cumulative effect on the individual receptors, or which otherwise would not be considered significant on its own.

## 9.4 Potential Impacts and Significant Effects

### Cumulative Effects with Other Committed Developments

9.4.1 The environmental impacts of the development proposals when considered cumulatively with the environmental impact of other existing adjacent and approved development projects at the time of submission of the ES is assessed for significance in the Table below

**Table 9-1: Committed developments that could combine with the proposed scheme to create a cumulative impact**

| Planning/ Marine Licence Reference Number | Description | Location | Status | Potential for Cumulative Effects | Significance |
|---|---|---|---|---|---|
| 20/01279/MJR | Renewal of 17/02130/MJR for the removal of fill material and the construction of a biomass power plant (up to 9.5mw) and a maximum of 130,000 sq. ft. of industrial accommodation (B8 use class), new | Rover Way, Pengam | Granted – 29th January 2021 | During construction could temporarily increase construction traffic along similar routes to the Cardiff Coastal Defences scheme, if construction overlapped. | Not significant |

| Planning/ Marine Licence Reference Number | Description | Location | Status | Potential for Cumulative Effects | Significance |
|---|---|---|---|---|---|
| | access roads and associated landscaping works \| land at Rover Way, Pengam | | | Potential impact on proposed rock storage areas. During operation character would change from undeveloped former tip to industrial. No detail available re proposed scale of landscape proposals to assess cumulative effects. | |
| 19/00397/MJR | On land at Lamby Way Landfill Site, Lamby Way, Wentlooog, Cardiff, CF3 2HP for the installation of a ground mounted Photovoltaic Solar Farm and ancillary development – Granted on 16th May 2019 | Lamby Way Tip | Under construction | Solar farm likely to be complete before the construction of Cardiff Coastal Defences scheme. Potential for cumulative landscape and visual effects as will increase the urban character adjacent to the Rhymney. However, generally well screened by retained vegetation so not considered to be significant. | Not significant |

### Interrelationship Effects

9.4.2 The closest residential properties to the development proposals (on Page Drive off Beaufort Square, near Location 52 and the Traveller Site near Location 12) may be subject to synergistic interrelationship effects during construction, principally arising from the following:

- Visual impacts from construction activities;
- Disturbances from construction noise impacts during both the day time and night time;

- Light spill/glare impacts from site compounds at night; and
- Impacts from increases in construction related traffic.

9.4.3 However, impacts due to interrelationships are not expected to be significant given the existing baseline lighting, noise and traffic levels along Rover Way.

9.4.4 Individual impacts identified above (visual, noise, light spill and traffic) will be addressed through the development of a detailed Construction Environmental Management Plan (CEMP) by the successful contractor that is to be agreed with Local Authority.

9.4.5 A Community Liaison Officer will be appointed during the construction phase of the project to communicate and coordinate between the construction contractor and local residents. This will ensure that any disruptive construction activities are well communicated to residents in advance, and that the views or concerns of residents are taken into account by the construction contractor when planning any disruptive works. The Community Liaison Officer would also assist residents with complaints, with a view to having any issues of concern addressed.

## 9.5 Residual Effects

9.5.1 With the proposed mitigation measures identified cumulative effects of the scheme are not expected to be significant.

# 10 Conclusions

## 10.1 EIA outcomes

10.1.1 Table 10-1 below provides a summary of the significant effects, mitigation measures and residual effects identified in each of the chapters of the ES. For the purpose of this summary table, some significance scores have been adapted to reflect the standardised approach to significance scoring as detailed in Table 3 5. Refer to the individual topic specific ES chapters for the topic specific guidelines significance terminology.

## 10.2 Construction environmental management plan

10.2.1 A CEMP is to be prepared by the successful contactor prior to the start of construction.

**Table 10-1 Summary of significant effects, mitigation measures and residual effects**

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| Geomorphology and Coastal Processes | Mobilisation of excavated sediment during construction | Temporary Minor | Construction will be limited to short sections during any tidal working period. All intertidal work shall cease three hours before the anticipated high tide time. All tidal work schedules should be assessed two weeks in advance of the works to avoid storm events. Works will also cease during storm events. | **Not Significant** |
| | Operational impact on the local or wider hydrodynamic regime | Permanent Negligible | As much work as possible will be non-tidal and will cease before high tide. Rock armour will be constructed in sections that can be completed in one tidal cycle. | **Not Significant** |
| | Impact of proposals on sediment regime and sediment budget | Minor | Brushwood and coir matting is proposed to help retain mud on slopes following installation of the erosion protection. No material should be stored on the | **Not Significant** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | | | foreshore, to reduce the risk of scour to adjacent intertidal habitat. | |
| | Impact of new rock revetement on local hydrodynamic and sediment regimes | Minor | None proposed | **Not Significant** |
| | Impact on intertidal habitats within the estuary, through indirect geomorphological processes. | Permanent Minor | None proposed | **Not Significant** |
| Biodiversity and Nature Conservation | Damage, or loss of intertidal habitats that the area is designated for during the construction and operation phases due to the placement of rock armour within designated site boundary. Works within the Severn Estuary SAC will for the most part place more rock in areas of existing rock flood defence or historically discarded building materials. The works footprint will impact approximately: 3.4ha of habitat within the SAC. 2.9 ha of this consists of existing rock defences and discarded building materials. 0.45 ha consists of existing saltmarsh. | Permanent Moderate | For the most part the new rock revetment will be placed in areas of existing rock flood defence or historically discarded building materials.<br><br>Compensatory habitat for this scheme has already been provided for under the Welsh Government habitat creation scheme. | **Slight** |
| | Damage, or loss of intertidal habitats brought about by maintaining the existing alignment of the coastline through the provision of new hard defences (i.e. coastal squeeze). | Permanent Moderate | Compensatory habitat for this scheme has already been provided for under the Welsh Government habitat creation scheme. | **Slight** |
| | Piling operations associated with the works have the potential to elicit behavioural impacts on migrating fish species of | Temporary Slight | Piling works will be undertaken in the dry Vibration piling (using a variable moment vibrator and a 'soft start' | **Not Significant** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | importance passing through the area. | | approach) should be used wherever possible. | |
| | Direct damage to maritime habitats via pollution and run-off. | Temporary Major | Industry standard construction practices as detailed in the construction management plan. All machinery to be in good condition and to be checked daily to prevent pollution incidents. Drip trays will be used to prevent oil leaking from machinery when parked/stored, and during refuelling of machinery. If fuel spillages happen due to refuelling, they will be carefully contained, to ensure they will not be released into the estuary. Where there is potential for pollutants to be escape in drainage water, this will be collected, passed through settlement and oil interception facilities to remove pollutants before being discharged to the estuary. A Construction Environmental Management Plan (CEMP) will be produced during the pre-construction period and implemented during construction period to minimise the risk of pollution events occurring. The application of good | **Not Significant** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | | | practice construction methodology, through the implementation of a CEMP to control the use and storage of potentially contaminating materials and litter, will further avoid any likely significant effects on coastal habitats during the construction phase. An Ecological Clerk of Works (ECoW) will be appointed to oversee this | |
| | Damage, or loss of intertidal habitats within the Rhymney Estuary during the construction and operation phases due to the placement of rock armour within designated site boundary. | Moderate | Alignment of the scheme has been designed to minimise habitat removal and fragmentation. Intertidal habitats directly impacted by the scheme comprise steep sections of the river bank on the outside of the bends. It is not considered that these areas provide foraging or roost potential for bird species associated with the protected site. Bird survey data obtained through surveys reveals that the areas identified to be lost are not utilised by migratory or wintering bird species. Areas of saltmarsh that have been identified as high tide roosts by NRW will not be impacted upon by the scheme. As | **Slight** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | | | part of the scheme the area of saltmarsh identified as degraded in the NVC detailed above will be improved by the discouragement of horse grazing. Impacts will also be assessed within the HRA. | |
| | Disturbance to overwintering and migratory bird species | Temporary Moderate | Sensitive areas adjacent to the Rhymney and Severn Estuaries have been identified and will be subject to a 2 hour tidal restriction either side of high tide to avoid impacts on birds utilising these habitats at high tide. This will be monitored by an ECoW. | **Not significant** |
| | Damage, disturbance, degradation, or loss of species during the construction and operation phases due to the placement of rock armour and scour protection on habitats. | Temporary Slight | Alignment of the scheme designed to minimise habitat removal and fragmentation. Replacement of removed habitats, with connectivity to existing habitats. | **Negligible** |
| | Spread of Japanese Knotweed during the construction phase will lead to long-term impacts on surrounding area as they outcompete native vegetation. | Slight | INNS method statements to be followed during construction. Biosecurity measures. | **Negligible** |
| | Killing/injury and/or noise or visual disturbance to reptiles during the construction phase. Loss or damage to habitat due to the operation of the | Temporary Slight | Alignment of the Scheme designed to minimise removal of habitat for reptiles. Replacement of removed habitat, | **Negligible** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | scheme will affect reptile assemblages. | | with connectivity to existing habitats, and enhancement of existing habitats. Vegetation clearance undertaken under ecological supervision. | |
| Landscape | Landscape Feature: the foreshore of the estuary – Year 15 winter – unifying effect of the works | Moderate beneficial | Not applicable | **Significant** |
| | Landscape Character Area: Coastal – Construction – disruption to the tranquillity | Moderate adverse | Good construction practices | **Significant** |
| | Landscape Character Area: Coastal – Year 15 winter – unifying effect of the works | Moderate beneficial | Not applicable | **Significant** |
| | Visual: Residents in the north of the study area – Construction – noticeable deterioration in their views towards site | Moderate adverse | Good construction practices | **Significant** |
| | Visual: Residents of the Traveller's Site on Rover Way – Construction – noticeable deterioration in their views in close proximity to construction traffic and works | Moderate adverse | Good construction practices; planting and a privacy fence | **Significant** |
| | Visual: Receptors on the WCP and PRoW – Construction – temporary diversions and clear views of the works and construction vehicles in close proximity | Moderate-substantial adverse | Good construction practices; planting at the Queen's Gate Roundabout | **Significant** |
| | Visual: Receptors using Rhymney River Motorboat Sail & Angling Club / river – Construction – some clear views of the works and construction vehicles in close proximity | Moderate adverse | Good construction practices | **Significant** |
| | The Modern anti-invasion defence/decoy site (RE007) potentially lies within the footprint of the Location 21 works, | Moderate adverse | Any groundbreaking activities within the vicinity of this asset is subject to archaeological monitoring in the | **Negligible** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | though its survival is unclear. | | form of a watching brief carried out by a suitably qualified archaeologist. The watching brief should be carried out in accordance with a Written Scheme of Investigation approved by Glamorgan-Gwent Archaeological Trust. | |
| Historic Environment | Drainage ditch of unknown date (02324s) potentially lies within the footprint of the Location 11 works, though its survival is unclear. | Moderate adverse | Any groundbreaking activities within the vicinity of this asset is subject to archaeological monitoring in the form of a watching brief carried out by a suitably qualified archaeologist. The watching brief should be carried out in accordance with a Written Scheme of Investigation approved by Glamorgan-Gwent Archaeological Trust. | **Negligible** |
| | Modern airfield structure (RE008) lies outside of the footprint of the development, but may potentially be impacted by construction activities. | Moderate adverse | It is recommended that this asset is fenced to protect from vehicle movements or accidental damage during construction. The type of fencing and buffer distance around the assets will be confirmed prior to construction beginning. | **Negligible** |
| | Medieval mill (02788s) lies outside of the footprint of the development, but may potentially be impacted by construction activities. | Moderate adverse | It is recommended that this asset is fenced to protect from vehicle movements or accidental damage during construction. The type of fencing | **Negligible** |

| Environmental Topic | Potential Likely Significant Effect | Significance Score | Proposed Mitigation | Residual Effect Significance Score |
|---|---|---|---|---|
| | | | and buffer distance around the assets will be confirmed prior to construction beginning. | |
| | There is a low potential for groundbreaking activities associated with construction of rock armour to encounter previously unknown buried archaeological remains, specifically in those areas where works encounter tidal flat deposits. There is also a low potential for works at Location 11 to encounter paleoenvironmental deposits in the form of peat. | Slight | It is recommended that any further pre-construction ground investigation works are monitored and the results analysed to further determine the potential for encountering unknown archaeological remains and palaeoenvironmental deposits. Following the GI works the requirement for implementation of a suitable scheme of mitigation such as monitoring through a watching brief can be determined. | **Negligible** |
| | During construction there will be impacts on the setting of the Gwent Levels Historic Landscape of Outstanding Historic Interest in Wales arising from construction activities | Temporary Minor | Existing mitigation in the form of modern developments located between the site boundary and the Gwent Levels will reduce the impacts of the scheme on the wider historic landscape | **Not Significant** |

# Appendices

**Appendix A: NRW EIA Screening Opinion**

**Appendix B: Cardiff Council EIA Scoping Opinion**

**Appendix C: Ecology Phase 1 Study Area**

**Appendix D: Sites of Importance for Nature Conservation (SINC) within 1km of the proposed development**

**Appendix E: Extent of the LANDMAP aspect areas**

**Appendix F: Summary of the LANDMAP aspect attribute tables**

**Appendix G: Landscape viewpoints**

**Appendix H: Landscape Mitigation Plan**

**Appendix I: Glamorgan-Gwent Archaeological Trust Desk-Based Assessment**

**Appendix J: Designated heritage assets**

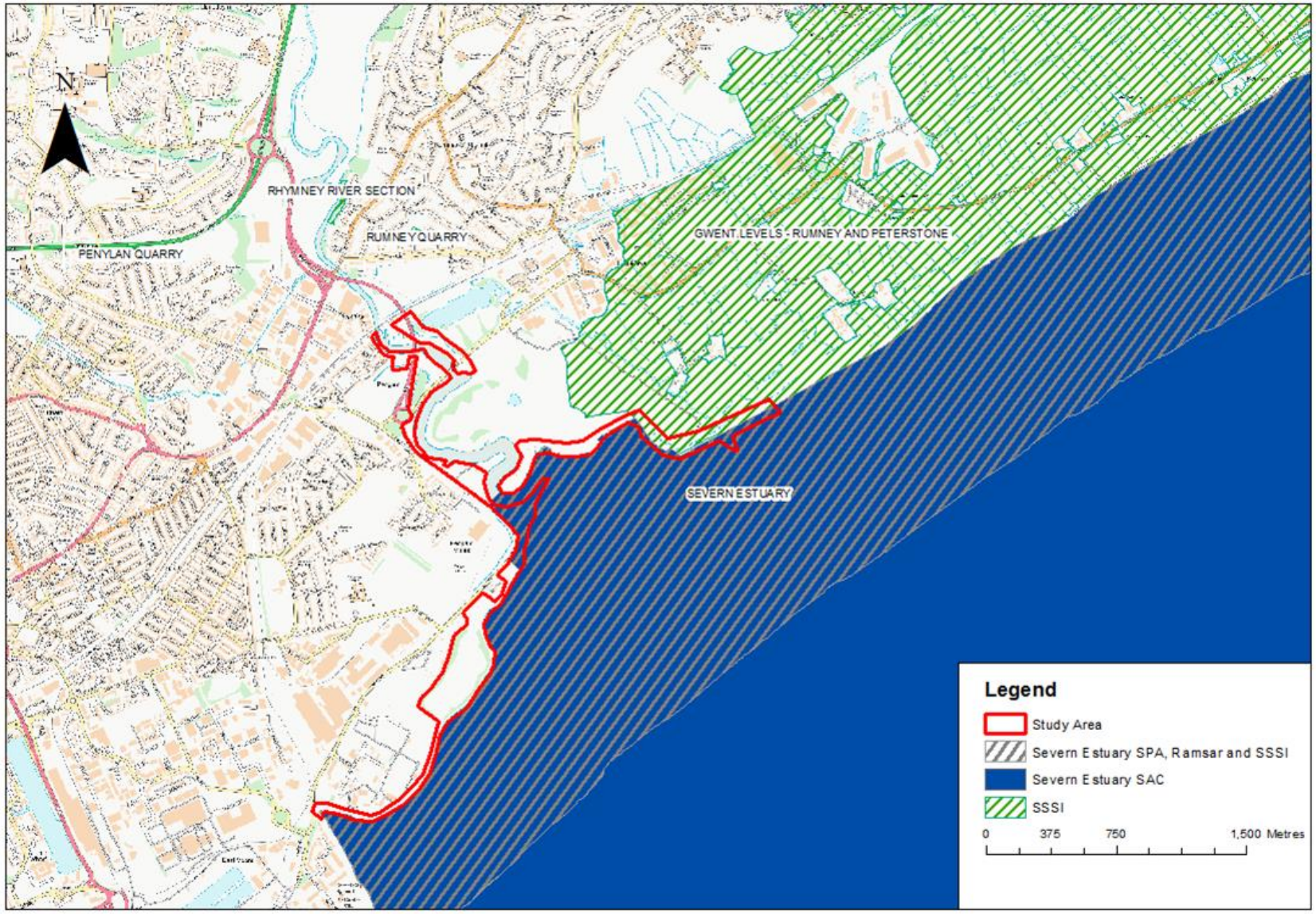
**Appendix K: Glamorgan-Gwent Archaeological Trust Site Walkover Survey**

**Appendix L: Ground Investigation Report**

# Appendix A: NRW EIA Screening Opinion

# Appendix B: Cardiff Council EIA Scoping Opinion

## Appendix C: Ecology Phase 1 Study Area



## Appendix D: Sites of Importance for Nature Conservation (SINC) within 1km of the proposed development