Mumbles Coastal Defence Scheme

Design Input Statement

August 2021

www.jbaconsulting.com

For Amey Consulting

JBA Project Manager

Juan Pablo Villagra Sar
JBA Consulting
35 Perrymount Road
Haywards Heath
West Sussex
RH16 3BW

Revision History

Revision Ref/Date	Amendments	Issued to
P01 / 03.08.2021	-	Lee Selway

Contract

Prepared by ..... Juan Pablo Villagra MEng MSc DIC

Senior Engineer

Reviewed by ..... David Potts CEng MICE

Chartered Senior Engineer

Approved by..... Alexander Lee CEng MICE

Technical Director

Purpose

This document has been prepared as a Draft Report for Amey Consulting. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Amey Consulting and the City and County of Swansea.

Copyright

© Jeremy Benn Associates Limited 2021.

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 58g if 100% post-consumer recycled paper is used and 73g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Contents

List of Figures

List of Tables

Abbreviations

mOD	Above Ordnance Datum (at Newlyn)

1 Project details

The City and County of Swansea ('the Council') has procured a multidiscipline consultancy team for the design and development of the Mumbles Coastal Protection project. The project forms part of the Welsh Governments Coastal Risk Management Programme. It provides an opportunity to address the current issues of the condition of the Mumbles' seawall and address long-term flood risk affecting the community. It will also deliver improvements to the amenity and recreation value of the promenade for visitors and residents.

1.1 Scope of the consultancy team design service

The project team has been engaged to develop the previous design work from the OBC stage of the project. Following this, technical design for consenting and detailed design for construction will be undertaken in line with the project objectives. Further details can be found in Schedule 2 (Scope & Specification of the Requirement) of the contract.

1.1.1 JBA's scope

JBA Consulting (JBA) are providing coastal defence design and consenting services to Amey Consulting as one of two sub-consultants in the multidiscipline consultancy team. LDA Design have also been commissioned by Amey Consulting and are providing landscape design services. Amey Consulting are acting as the Lead Consultant for the project and provide the scoped design service to the Council. JBA have design responsibility for the works seaward of the primary seawall defence, up to and including this defence, as well as responsibility for the provision of certain environmental and consenting services.

1.2 Document purpose

This Design Input Statement (DIS) provides details of the key assumptions and methodology expected to be used by JBA in our design. The final design will be accompanied by a Design Technical Note (DTN) detailing the process undertaken to arrive at the final design.

1.3 Previous work

An Outline Business Case (OBC) has previously been prepared by Arup and considered by the WG Coastal and Risk Management Board in September 2017. The Council was formally advised of its successful funding bid to develop the FBC in January 2018. In 2019 further studies were undertaken by Arup, WYG and GGAT to reduce uncertainties identified in the OBC.

2 Site details

Mumbles Bay is located near Swansea in South Wales. The project extends from Knab Rock slipway in the southeast (approx. grid reference SS 62394 87729) to beyond the Dairy Car Park in the northwest (approx. grid reference SS 61579 88472). The extent is shown in Figure 2.1 and in the drawings produced at OBC stage. The existing primary defence comprises a sloped concrete revetment in the southeast for a length of approximately 500m and a vertical sea wall in the northwest for a length of approximately 700m. Secondary defences are also present along the frontage, generally in the form of a set-back masonry wall, although to the northwest a grassed embankment behind the promenade acts as the secondary defence.

Figure 2.1: Extents of Mumbles coastal defence scheme

3 Proposed solution

3.1 Description of scheme and design working life

The features of the new coastal defence scheme are expected to be as follows:

- Construct a primary coastal defence upstand wall seaward of the promenade as required to achieve the required wave overtopping standard.
- Maintain or widen the existing promenade and revise the promenade level as appropriate.
- Construct a set-back secondary coastal defence wall (splashwall) as required to achieve the required wave overtopping standard.
- Undertake suitable works to strengthen the face of the 500m length of existing seawall, including consideration of possible scour and beach lowering of the foreshore.
- Undertake suitable works to strengthen the 700m length of existing revetment, including consideration of possible scour and beach lowering on the foreshore.

The design working life, including the structural design life of the concrete elements, is expected to be 100 years, although aspects of the designed scheme will require adaption in 50 years to improve the standard of defence. A 50-year design life may be adopted should there be certainty that a specific element will be redundant following the adaption of the defence, allowing for the uncertainty in how the defence will be adapted.

Further information on the adaptive design pathway is given in COGL00000009-JBAU-00-00-TN-C-0003-2120_adaptive_pathway_design_technical_note.

Further information on the design storm conditions is given in Section 94.4.

3.2 Structural type

The project area is expected to be split into three frontages with three different design cross-sections. The expected frontages are shown in Figure 3.1 and the expected cross-sections are as described in Table 3.1.

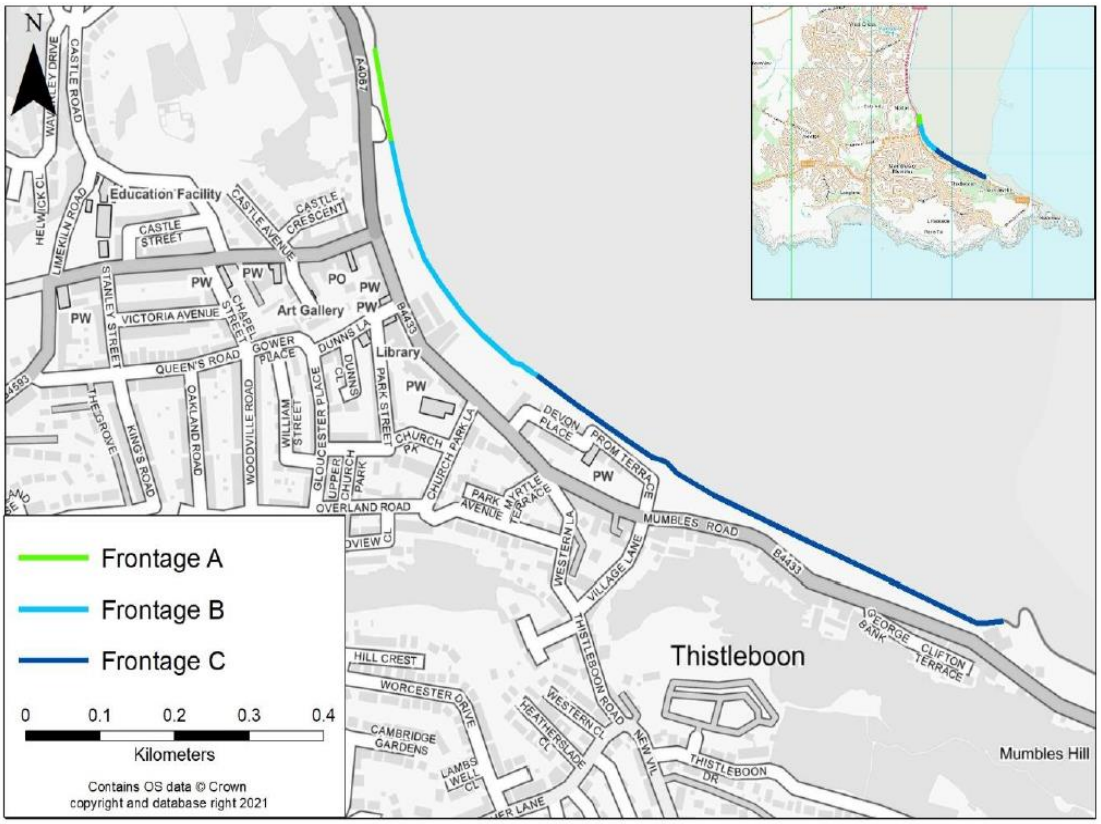


Figure 3.1: Expected design frontages

Table 3.1: Design cross-section descriptions

Frontage	Description
Frontage A	Existing seawall with promenade at a level of +6.5mOD or above. Existing ground levels landward of the promenade at a level of +7.9mOD or above, providing natural secondary defence. Expected design cross-section to include the encasement of the seaward face of the existing seawall with reinforced concrete. In addition, a reinforced concrete stepped apron with sheet pile at the toe of the wall will be included alongside the replacement of material retained behind the seawall with lightweight fill.
Frontage B	Existing seawall with promenade at a level below +6.5mOD. No natural secondary defence, although existing splash wall present in places. Expected design cross-section to include the encasement of the seaward face of the existing seawall with reinforced concrete. In addition, a reinforced concrete stepped apron with sheet pile at the toe of the wall will be included alongside the replacement of material retained behind the seawall with lightweight fill. A reinforced concrete recurve upstand will be added to the top of the seawall to achieve a top level of +7.2mOD and a secondary defence with a top level of +7.2mOD will be provided. Existing promenade levels will be raised to +6.5mOD.
Frontage C	Existing concrete sloping revetment with promenade generally at a level below +6.5mOD. No natural secondary defence, although existing splash wall present in places.

	Expected design cross-section to include the replacement of the concrete revetment face with new reinforced concrete slab. A steel sheet pile wall will be designed for the toe of this revetment. A reinforced concrete recurve upstand will be added to the top of the revetment to achieve a top level of +7.5mOD and a secondary defence with a top level of +7.4mOD will be provided. Existing promenade levels will be raised to +6.5mOD.

3.3 Foundation type

A range of structures and founding soils are anticipated, requiring different design approaches for foundation design. Some elements will be designed to be supported by the existing seawall, some will be founded on foreshore material and some on the made ground below the promenade and revetment.

In general, design will utilise bearing type (pad) foundation design, although sheet pile toe details will require different analysis techniques.

3.4 Jointing

Expansion and contraction joints will be incorporated into the design to allow for movement associated with thermal effects. Construction joints will consider pre-casting and in-situ concrete methods. Reasonable measures to manage differential settlement of the existing wall will be considered but this effect may not be fully managed through design. Inspection and maintenance is considered a reasonable approach to manage this risk.

3.5 Classes and levels

A consequence class of CC2, or 'medium consequence for loss of human life, economic, social or environmental consequences' is assumed for the primary seawall design work as defined in BS EN 1990.

An associated Reliability Class of RC2 and Inspection Level of IL2 is also assumed as defined in BS EN 1990.

3.6 Restraint systems requirements

The primary seawall will continue to present a hazard for falling from height which will require management through design. JBA will be responsible for the design process relating to appropriate restraint system requirements with the required input of our project partners.

3.7 Drainage

JBA will contribute to discussions relating to drainage design and Amey are lead designer for these elements. The anticipated drainage systems required to manage wave overtopping are as follows:

- Direct drainage of the promenade area (between primary and secondary defence) using drainage slots through the primary wall stem. It is expected this drainage will incorporate a non-return system.
- Buried drainage behind the secondary wall with capacity to manage wave overtopping volumes in this area. Outfalls to the foreshore are also anticipated requiring non-return system.

Consideration of additional drainage requirements is outside of the scope of JBA's work.

3.8 Proposed arrangements for future maintenance and inspection

The design of the primary seawall will generally adopt principles to minimise the need for maintenance work. At this stage, it is not anticipated that significant planned maintenance work will be required during the design life of these structures. However, inspection and reactive maintenance work should be included within asset management planning.

Visual inspection should be possible from the publicly accessible promenade and foreshore. Traffic Management will not be required in these areas, although access to the foreshore will require appropriate planning to ensure suitable tides. Visual aids (zoom camera or binoculars) may be required to see elements of the structure at higher elevations.

Touching distance inspections are expected to require the use of temporary safe working platforms to achieve access. Use of a suitable MEWP from the foreshore is anticipated, although alternative access methods would be possible. It is not expected that the concrete revetment will be designed for pedestrian access and so the required use of a MEWP in these locations is also expected.

Some elements will be buried during normal operation and may not be exposed during the working life of the structures. It is not expected that these elements will require visual inspection.

Maintenance works are expected to require machine access on the promenade and on the foreshore.

3.9 Environment

There are five statutory designated sites within a 2km search area of the site, all of which are designated Sites of Special Scientific Interest (SSSI). Within a 5km search of the site there is a further three statutory designated sites, designated as Special Areas of Conservation (SAC). There are six locally designated non-statutory sites within 2km search boundary of the proposed site. These include Pell Wood Wildlife Trust Reserve and 5 Sites of Importance in Nature Conservation (SINC).

Mumbles foreshore is designated as part of the Blackpill Swansea Site of Special Scientific Interest (SSSI), Bristol Channel Approaches Special Area of Conservation (SAC) and Swansea Bay Site of Importance for Nature conservation (SINC). Designated as SSSI due to its importance as an overwintering site for large numbers of waders. A Marine License and SSSI Assent from Natural Resources Wales (NRW) will be required for works to progress on the foreshore and Blackpill Swansea SSSI.

A preliminary ecological assessment (PEA) has been completed by JBA to update surveys carried out by ARUP at the Project Appraisal Report (PAR) stage and has identified any likely ecological constraints and proposed mitigation measures in relation to the ecological receptors likely to be impacted as a result of the works. Furthermore, where applicable, recommendations for further surveys, such as specific species surveys, mitigation and ecological enhancements have been provided. In addition to the PEA other reporting has included a wintering birds survey report, Habitats Regulation Assessment (HRA) screening report and a Water framework Directive (WFD) screening report.

The Promenade area south of the Mumbles tennis courts is located within the Mumbles Conservation Area. Whilst the structure is not Listed, Mumbles is a distinctive and historic coastal community. The Glamorgan-Gwent Archaeological Trust (GGAT) completed an archaeological desk-based assessment in May 2019 for City and County of Swansea. GGAT identified nineteen assets as being potentially directly impacted by the scheme. A subsequent site visit was undertaken by JBA consulting to understand the site, heritage assets and their setting, identified a further five assets within the proposed site boundary. The desk-based heritage

assessment completed by JBA builds on the work completed by GGAT and has considered the impact on the setting of designated heritage assets within the vicinity of the scheme. An archaeological watching brief shall be carried out on any ground works to safeguard against damage to/loss of the archaeological resource.

The coastal protection project also seeks to realise opportunities to support the coastal integrated green grey infrastructure initiatives.

3.10 Durability – materials and finishes

The primary seawall upstand, seawall encasement, revetment and stepped toe detail will be designed to be reinforced concrete. The sheet pile toe detail will be designed to be steel.

Concrete finishes will be determined during design. Aesthetic considerations (e.g. sand blasting stencils) and ecological considerations (e.g. textured finishes) may be considered where there will be no impact on technical performance.

Sheet piles will be designed to be unfinished steel and will corrode during operation. These are expected to be largely unseen during operation, with an allowance of sacrificial steel to be made.

Where possible, concrete elements will be designed for construction using either pre-cast or in-situ techniques. Due to practical considerations, use of precast elements for the seawall encasement is unlikely to be feasible. This might be considered if reasonable suggestions are put forward by a contractor.

3.11 CDM regulations

JBA will act as a Designer under the Construction (Design and Maintenance) Regulations 2015. A designer's risk assessment will be developed and delivered for items designed by JBA to communicate relevant information.

3.12 Common hazards

3.12.1 UXO

It is understood that a detailed UXO desk study will be undertaken for the site and appropriate actions and recommendations will be managed by the Lead Consultant.

3.12.2 Buried and overhead services

It is understood several buried / overhead services will be affected by the works to be designed. Liaison with utility providers will be managed by the Lead Consultant and appropriate actions taken by JBA during the design.

3.12.3 Ground contamination

Ground investigations have been undertaken at the site with relevant testing and sampling information made available. JBA will produce a Geotechnical Interpretative Report which will analyse the available data and provide recommendations for adoption.

3.13 Costing information

JBA will provide information suitable for costing at various stages in the project. It is assumed that scheme costing will be undertaken by an ECI contractor or the Lead Consultant.

3.14 Construction arrangements

As part of the design risk assessment process, JBA will make appropriate consideration of how their design will be constructed. It is anticipated that this will include input by an ECI contractor. A buildability statement will be written as appropriate.

4 Design criteria

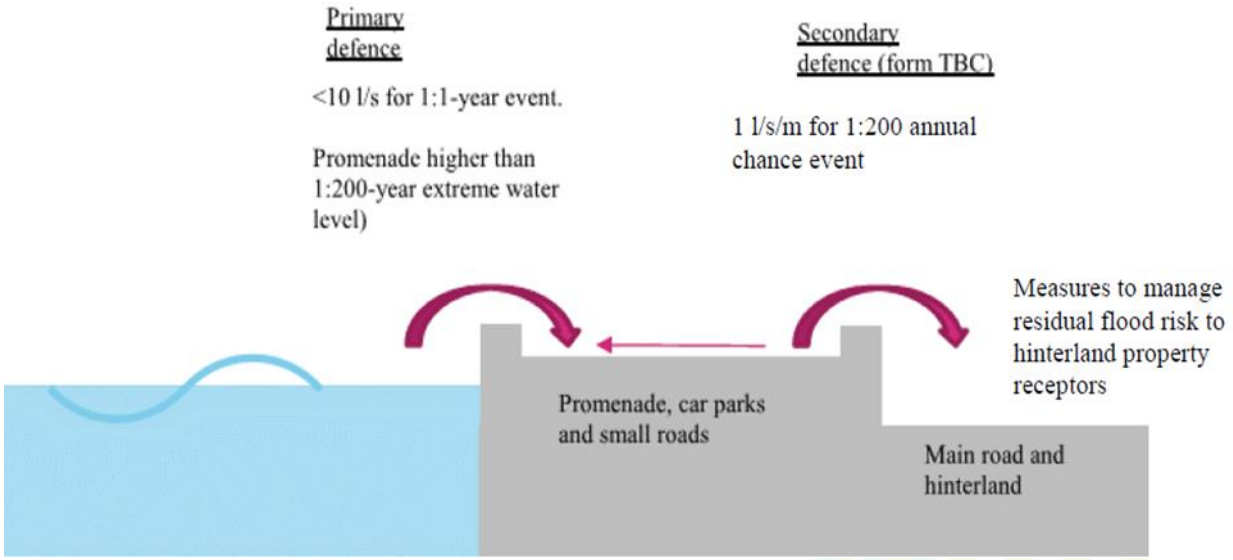
4.1 Overtopping performance requirements

Three overtopping performance requirements have been specified in the contract. These are as follows:

- Overtopping behind the primary defence less than 10 l/m/s (on average) during a 1:1-year event.
- Promenade level to be higher than a 1:200-year extreme water level
- Overtopping behind the secondary defence less than 1 l/m/s (on average) during a 1:200-year event.

A climate change allowance to 2070 will be incorporated into the design.

In addition to these requirements, best practice guidance provided in the European Wave Overtopping Manual (Second Edition) will be considered during design.



4.2 Loading

The following loads will be considered during design:

- Permanent (self-weight) loads
- Wave impact loads
- Thermal loads arising from heat of hydration in concrete only
- Loads arising from active, passive and at-rest soil pressure
- Imposed loading on the promenade (pedestrian loading and / or vehicle loading)

4.3 Standards and guidance for use in design

A list of standards and guidance for use in the technical design of the primary sea defence is provided below. Further documents may be used, as necessary.

- BS EN 1990:2002 Eurocode - Basis of structural design (+A1:2005) (incorporating corrigendum December 2008 and April 2010)
- NA to BS EN 1990:2002:2004 UK National annex for Eurocode - Basis of structural design (incorporating National amendment No. 1)
- BS EN 1991-1-1:2002 Eurocode 1: Actions on structures. General actions - Densities, self-weight, imposed loads for buildings (incorporating corrigenda December 2004 and March 2009)
- NA to BS EN 1991-1-1:2002:2005 UK National annex to Eurocode 1: Actions on structures. General actions - densities, self-weight, imposed loads for buildings (Incorporating corrigendum July 2019)
- BS EN 1991-1-5:2003 Eurocode 1: Actions on structures. General actions - Thermal actions (incorporating corrigenda December 2004 and March 2009)
- NA to BS EN 1991-1-5:2003:2007 UK National Annex to Eurocode 1: Actions on structures. General actions - Thermal actions
- BS EN 1992-1-1:2004 Eurocode 2: Design of concrete structures. General rules and rules for buildings (+A1:2014) (incorporating corrigenda January 2008, November 2010 and January 2014)
- NA to BS EN 1992-1-1:2004:2005 UK National annex to Eurocode 2: Design of concrete structures. General rules and rules for buildings (+A2:2014)
- BS EN 1992-3:2006 Eurocode 2: Design of concrete structures. Liquid retaining and containment structures
- NA to BS EN 1992-3:2006:2007 UK National Annex to Eurocode 2: Design of concrete structures. Liquid retaining and containment structures
- BS EN 1993-1-1:2005 Eurocode 3: Design of steel structures. General rules and rules for buildings (+A1:2014) (incorporating corrigenda February 2006 and April 2009)
- NA to BS EN 1993-1-1:2005:2008 UK National Annex to Eurocode 3: Design of steel structures. General rules and rules for buildings (+A1:2014)
- BS EN 1993-5:2007 Eurocode 3: Design of steel structures. Piling (incorporating corrigendum May 2009)
- NA to BS EN 1993-5:2007:2009 UK National Annex to Eurocode 3: Design of steel structures. Piling (+A1:2012)

- BS EN 1997-1:2004 Eurocode 7: Geotechnical design. General rules (+A1:2013) (incorporating corrigendum February 2009)
- NA to BS EN 1997-1:2004:2007 UK National annex to Eurocode 7: Geotechnical design. General rules (+A1:2014) (incorporating Corrigendum No. 1)
- BS EN 1997-2:2007 Eurocode 7: Geotechnical design. Ground investigation and testing (incorporating corrigendum June 2010)
- NA to BS EN 1997-2:2007:2009 UK National Annex to Eurocode 7: Geotechnical design. Ground investigation and testing
- BS 6349-1-1:2013 Maritime works. General - Code of practice for planning and design for operations
- BS 6349-1-2:2016 Maritime works. General - code of practice for assessment of actions (+A1:2017) (Incorporating corrigendum No. 1)
- BS 6349-1-3:2021 Maritime works. General - code of practice for geotechnical design
- BS 6349-1-4:2013 Maritime works. General - Code of practice for materials
- BS 6349-2:2019 Maritime works. Code of practice for the design of quay walls, jetties and dolphins
- BS 6349-7:1991 Maritime structures. Guide to the design and construction of breakwaters (incorporating corrigendum January 2010)
- ISO 21650:2007 Actions from waves and currents on coastal structures
- CIRIA Publication C766 Control of cracking caused by restrained deformation in concrete (includes errata February and March 2019)
- CIRIA Publication C674 Use of concrete in maritime engineering: a guide to good practice
- McConnell, K (1998), Revetment Systems Against Wave Attack – A design manual

4.4 Data used as basis for design

A range of data from various sources shall be used to undertake the design. Description is provided below indicating key information and / or sources of data. Data from other sources may be used, as necessary.

4.4.1 Tide levels

Level information is generally provided in metres to Ordnance Datum (mOD). The Admiralty tide tables (Volume 1B) state that the chart datum (CD) is at -5.0mOD at Mumbles. Tide levels used for this project are shown in Table 4.1 and are as indicated in the 'Mumbles Conceptual Understanding' by ABPMer for Arup as part of the project's OBC.

Table 4.1: Astronomic tide levels at Mumbles

Tidal level	Present day water levels (mOD)
Highest Astronomical Tide (HAT)	+5.5
Mean High Water Springs (MHWS)	+4.5
Mean High Water Neaps (MHWN)	+2.2
Mean Sea Level (MSL)	+0.2
Mean Low Water Neaps (MLWN)	-1.7
Mean Low Water Springs (MLWS)	-3.9
Lowest Astronomical Tide (LAT)	-4.9

4.4.2 Design storm conditions

The storm conditions for use in design have been adopted from the physical modelling specification adopted during the previous phase of the project. These were determined by ABPMer on behalf of Arup. The design conditions can be divided into five categories as follows:

- Design storm(s) in the year 2070 with a 1:1-year return period
- Design storm(s) in the year 2070 with a 1:200-year return period
- Design storm(s) in the year 2120 with a 1:200-year return period
- Design storm(s) in the year 2120 with a 1:200-year return period accounting for the effects of the construction of Swansea tidal lagoon

These storm conditions are shown in Table 4.2.

Table 4.2: Design storm conditions

Design case	Wave climate ID	Significant wave height (m)	Peak wave period (s)	Still water level (mOD)
1:1-year 2070	WC1	0.4	5.0	+4.5
	WC2	0.4	9.5	+5.6
1:200-year 2070	WC3	1.6	6.4	+4.8
	WC4	1.1	6.4	+4.8
	WC5	1.6	6.2	+5.4
	WC6	1.0	6.1	+5.4
	WC7	1.4	5.7	+5.6
	WC8	0.6	12.3	+6.3
1:200-year 2120	WC9	1.5	5.8	+6.3
1:200-year 2120 (tidal lagoon)	WC10	1.2	12.7	+6.8

4.4.3 Extreme water level

The extreme water level for use in design is taken to be the Mumbles 1:200-year event in 2070. This has been calculated using the Coastal Flood Boundary Dataset 2018 and current climate change guidance[1]. As the business case for this project commenced before 1 April 2021, this project comes under the transitional arrangements in the latest climate change guidance. The OBC was completed using the previous climate change guidance; however, the transitional arrangements require this project to assess the preferred option against the revised allowances to ensure that results would not lead to significantly different decisions at detailed design stage and to undertake detailed design using the revised allowances if work is not too far progressed to allow this. The revised climate change allowance is UKCP18, RCP8.5, 70th percentile. The Coastal Flood Boundary 1:200-year water level for the site is 6.34mOD (base year 2017). Using the revised climate change allowance, the mean sea level increase from 2017 to present day (2021) is 0.02m and thus the 200-year water level in 2021 is 6.36mOD; with the addition of 0.39m climate change allowance to the year 2070, the extreme water level for use in design is 6.75mOD.

4.4.4 Wave loading data

Wave loading data collected during the physical modelling of various scenarios will be used in the design process. Suitable partial factors and adjustment factors will be applied from relevant documents and literature for use in design. Raw wave loading data will be as supplied by Imperial College London.

4.4.5 Topographic data

The topographic information to be used in design will be the provided traditional topographic survey data undertaken by John Vincent Survey Ltd in February 2019. There are currently no known plans to undertake a beach level survey prior to tendering the construction works.

In addition to the topographic survey, several other topographic information sources are available for cross-reference and graphical use as follows:

- Point cloud data provided by the Council
- LiDAR survey
- Ordnance Survey mapping (MasterMap) provided by the Council

5 Analysis methods

5.1 Overtopping rates

Overtopping rates will be derived directly from the physical modelling undertaken in relation to the project. The worst-case overtopping rates from these laboratory tests will be used to confirm compliance with design requirements and to inform drainage design and residual flood risk.

5.2 Residual flood risk

Flood inundation modelling has been undertaken using TUFLOW using the overtopping rates obtained from the physical modelling to assess residual flood risk behind the secondary wall. Drainage of the overtopping volume will be required to

[1] Adapting to Climate Change: Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales. April 2021.

manage the residual flood risk. Demonstration of the effectiveness of the proposed drainage arrangements may be required during the design process.

5.3 Coastal processes

Coastal processes interacting with the design have been determined through the review of information produced at OBC stage by ABPmer on behalf of Arup in March 2017. This review identifies new data and provides guidance to inform the design of the different defence options.

5.4 Concept design for 2070-2120 adaptive pathway epoch

A concept design has been developed for the 2070-2120 epoch, using the wave climates WC09 and WC10 shown in Table 4.2. The design comprises a raised sea wall and rock revetment. The design was achieved using the relevant nearshore wave dataset and the Artificial Neural Network. A number of sea wall heights and revetment crest widths, heights, slopes and roughnesses were tested to identify profiles that achieve a tolerable level of overtopping.

5.5 Selection of preferred option

A multicriteria analysis, taking account of political, economic, social, technical, legal, and environmental criteria has been undertaken for solutions presented in the early stages of the design process. In combination with high level costing information, this process led to the selection of current solution for development through the design process.

5.6 Risk register and Monte Carlo analysis

JBA will continue to develop a register of construction risks identified during design, these risks will be assigned a probability of occurrence according to engineering judgement and in consultation with others.

In addition, a minimum, most likely and maximum cost will be estimated for each risk to undertake Monte Carlo analysis. This will be based upon costing information obtained from the ECI contractor and engineering judgement for possible programme delays.

5.7 Structural and geotechnical design

The structures will be designed for both Ultimate Limit State (ULS) and Serviceability Limit State (SLS) conditions using the information described in this document and any other relevant information. These will be determined in agreement with the standards described in Section 4.3 and other relevant documents.

Structural stability will be designed using static equilibrium calculations. Self-weight values will be determined from idealised geometry and material densities provided in Eurocode 1. Where applied loading is dynamic (e.g. wave loading), equivalent static loads will be determined for use in these calculations. Soil pressures will be calculated using the principles described in Eurocode 7 and an allowable imposed load for the promenade will be determined in kPa.

Reinforcement design to control early-age concrete cracking will be undertaken using the methodology described in CIRIA Publication C766. Consideration of internal shear and bending actions in the reinforced concrete will also be made and reinforcement designed appropriately according to the principles described in Eurocode 2 and this document.

Sheet piling stability will be designed using software idealising soil-structure interaction with elastic-plastic springs and beam elements. Suitable 2d sections will

be determined for use in this design. Load effects from this software will be used to confirm the suitability of the sheet piling cross-section in an iterative process. The resistance of sheet piling to load effects will be determined using the methods described in Eurocode 3.

Soil bearing capacities will be determined using the principles described in Eurocode 7 and applied bearing pressures determined from static equilibrium calculations as described previously.

6 Geotechnical conditions

6.1 Engineering properties

Two ground investigations were undertaken as part of the OBC stage of the project. The investigations were specified by Arup and undertaken by WYG. Factual information for both investigations is available for use, alongside a GIR produced by Arup covering the first set of investigations.

As part of their work, JBA have undertaken a gap analysis on the geotechnical information and identified further investigations to manage design and operational risk. However, the level of risk without these investigations has been accepted by the Council, and it is understood there is no intention of undertaking the full scope of investigations outlined in the gap analysis. However, 2No. trial holes were dug into the existing coastal revetment to determine that no redundant vertical wall structure is present behind the slope.

JBA will produce a Geotechnical Interpretative Report and Geotechnical Design Report using the information available. Suitable assumptions will be made where necessary to complete the design, this is deemed acceptable.

6.2 Contaminated land

Ground contamination information from the existing factual reports will be used to determine likely soil classifications and as part of the Design Risk Assessment.

7 Drawings and documents

7.1 Design intent

The design to be developed using the information detailed in this report is shown in the drawings listed in Table 7.1.

Table 7.1: Design intent drawings

Drawing number	Drawing title	Status	Revision
COGL00000009-JBAU-00-00-DR-C-1000	General arrangement	S3	P01
COGL00000009-JBAU-00-00-DR-C-1001	Site plan 1 of 4	S3	P01
COGL00000009-JBAU-00-00-DR-C-1002	Site plan 2 of 4	S3	P01
COGL00000009-JBAU-00-00-DR-C-1003	Site plan 3 of 4	S3	P01
COGL00000009-JBAU-00-00-DR-C-1004	Site plan 4 of 4	S3	P01
COGL00000009-JBAU-00-00-DR-C-1501	Typical Section A	S3	P01
COGL00000009-JBAU-00-00-DR-C-1502	Typical Section B	S3	P01
COGL00000009-JBAU-00-00-DR-C-1503	Typical Section C	S3	P01

7.2 Deliverables

The drawings and documents listed below are expected to form the JBA project deliverables. JBA will contribute information in relation to items within their scope, it is assumed that this will be compiled where applicable into a larger document covering all details of the works.

7.2.1 RIBA Stage 2

- Geotechnical Gap Analysis Technical Note
- Geotechnical Interpretive Report
- Physical Modelling Technical Note
- Flood Inundation Modelling Interpretive Report
- Coastal Processes Review
- Concept Design for 2070-2020 Adaptive Pathway Epoch Report
- Risk Register & Monte Carlo Analysis
- Drawings
- 3D model
- Designer's Risk Assessment
- Preliminary Ecological Assessment Report (PEA)
- Wintering Birds Survey Report
- Habitats Regulation Assessment Screening Report
- Water Framework Directive Screening Report
- Heritage Desk Based Assessment Report

7.2.2 RIBA Stage 3

- Design Input Statement
- Updated drawings
- Updated 3d model
- Updated Designer's Risk Assessment
- Town and Country Planning Act Consent
- Coast Protection Act Consent
- Marine Licence
- SSSI Ascent
- SAB Application approval

7.2.3 RIBA Stage 4

- Design Technical Note
- Drawings
- 3D model
- Specification
- Works Information
- Designer's Risk Assessment
- Environmental Action Plan

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
Follow us:

Jeremy Benn Associates Limited

Registered in England 3246693

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007