Flood Consequences Assessment

Porthcawl Waterfront Regeneration

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Prepared for:

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Issued by	**Stantec Hydrock Limited** Great Suffolk Yard 127-131 Great Suffolk Street London SE1 1PP UNITED KINGDOM stantec.com	+44(0) 203 8468456 stantec.com
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Prepared by		Eliane Gebauer BSc MSc MCWIEM
Checked by		Alexandros Petrakis BSc (Hons) MCWIEM C.WEM
Approved by		Alexandros Petrakis BSc (Hons) MCWIEM C.WEM

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1 Introduction

Stantec Hydrock Ltd have been commissioned by The Urbanists to undertake a Flood Consequences Assessment (FCA), for the proposed Porthcawl Waterfront Regeneration Project.

This report is an assessment of flood risk to the development, from on and off-site sources, and to off-site receptors arising from development at the site.

This report has been completed in accordance with Technical Advice Note 15: Development and Flood Risk (TAN15)[1] through:

- Assessing whether the proposed development is likely to be affected by flooding;
- Assessing whether the proposed development is appropriate in the suggested locations; and
- Detailing measures necessary to mitigate any flood risk identified; to ensure that the proposed development and occupants would be safe, and that flood risk would not be increased as a result of development.

[1] Technical Advice Note 15: Development, flooding and coastal erosion

2 Existing Site Conditions

2.1 Site Location

The site covers an area of 43.6 hectares (ha) and is located in Porthcawl, Wales. The site is bound:

- To the east by Trecco Bay Caravan Park;
- To the south by Sandy Bay;
- To the west by The Portway; and
- To the north by Griffin Park, Coney Beach Pleasure Park and the Sandy Bay Bowl open space area.

The site address and Ordnance Survey Grid Reference is provided in **Table 1** with the site location shown in **Figure 1**.

Table 1. Site Referencing Information

Site Referencing Information	
Site Address	Porthcawl Waterfront, Wales, CF36 5BT
Grid Reference	SS 82519 76950 282519, 176950

Figure 1: Site Location

2.2 Topography

Topographic levels to meters Above Ordnance Datum (m AOD) have been derived from a 1 m resolution Natural Resources Wales (NRW) composite Light Detecting and Ranging (LiDAR) Digital Terrain Model (DTM). A LiDAR plan is shown in **Figure 2**.

The DTM in **Figure 2** shows the site to range in elevation from 5.5m AOD to 18m AOD. This does not include the sections of the site that are not land based, such as Porthcawl Marina. The lowest elevation can be found in Griffin Park adjacent to the northern boundary. The highest elevation can be found in the green space to the north of Sandy Bay Campsite. A topographical survey was undertaken by Landmark Surveys Wales in September 2020 and has been provided in **Appendix A**.

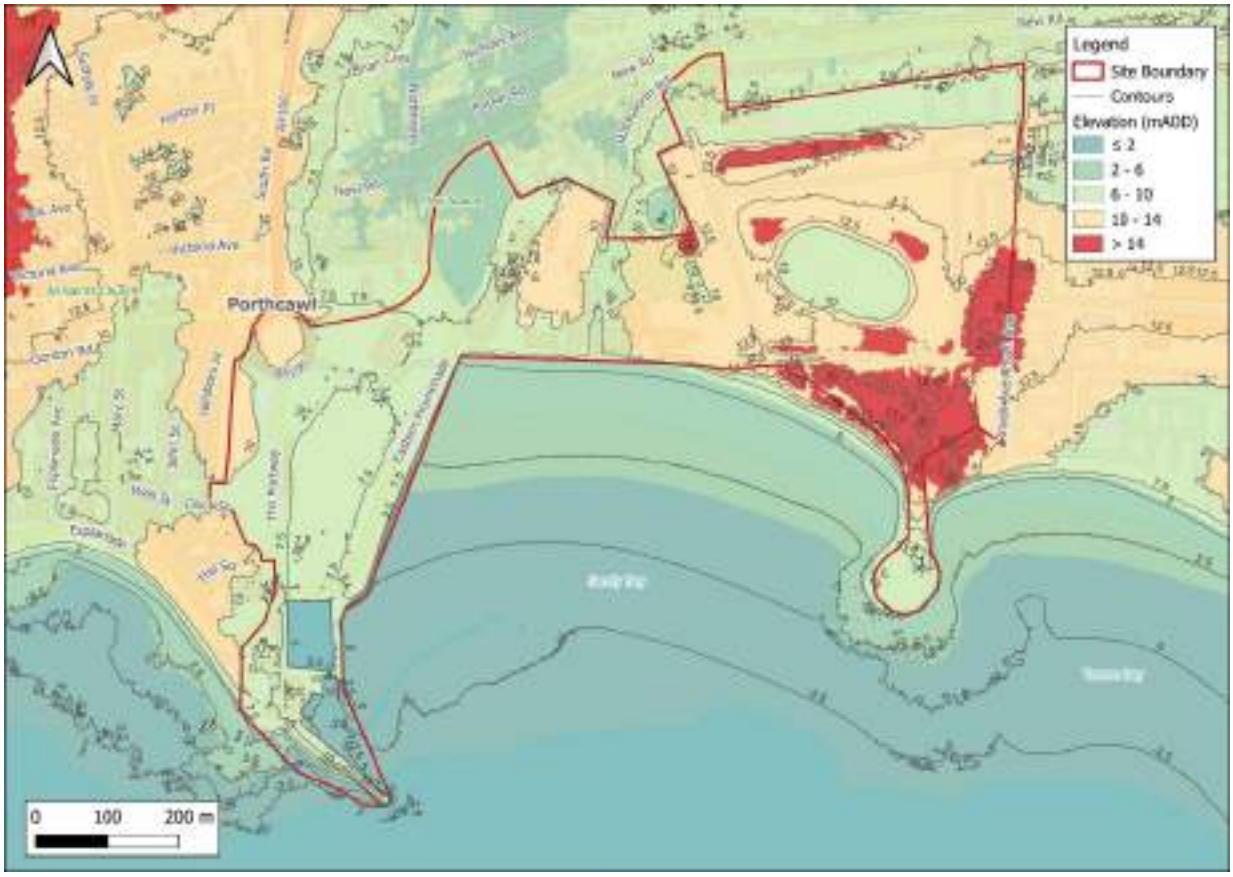

Figure 2: LiDAR Plan

2.3 Hydrology

The site lies immediately north of Sandy Bay within the tidal Bristol Channel, which is an inlet of the Atlantic Ocean. The Porthcawl Marina also lies within the site boundary.

The nearest Main River under Natural Resources Wales (NRW) jurisdiction is the River Ogmore, located approximately 2.80km east of the site as shown in **Figure 3**. The site lies within the Ogmore Operational Catchment in the Tawe to Cadoxton Management Catchment Water Framework Directive (WFD) Operational Catchments Cycle 2.

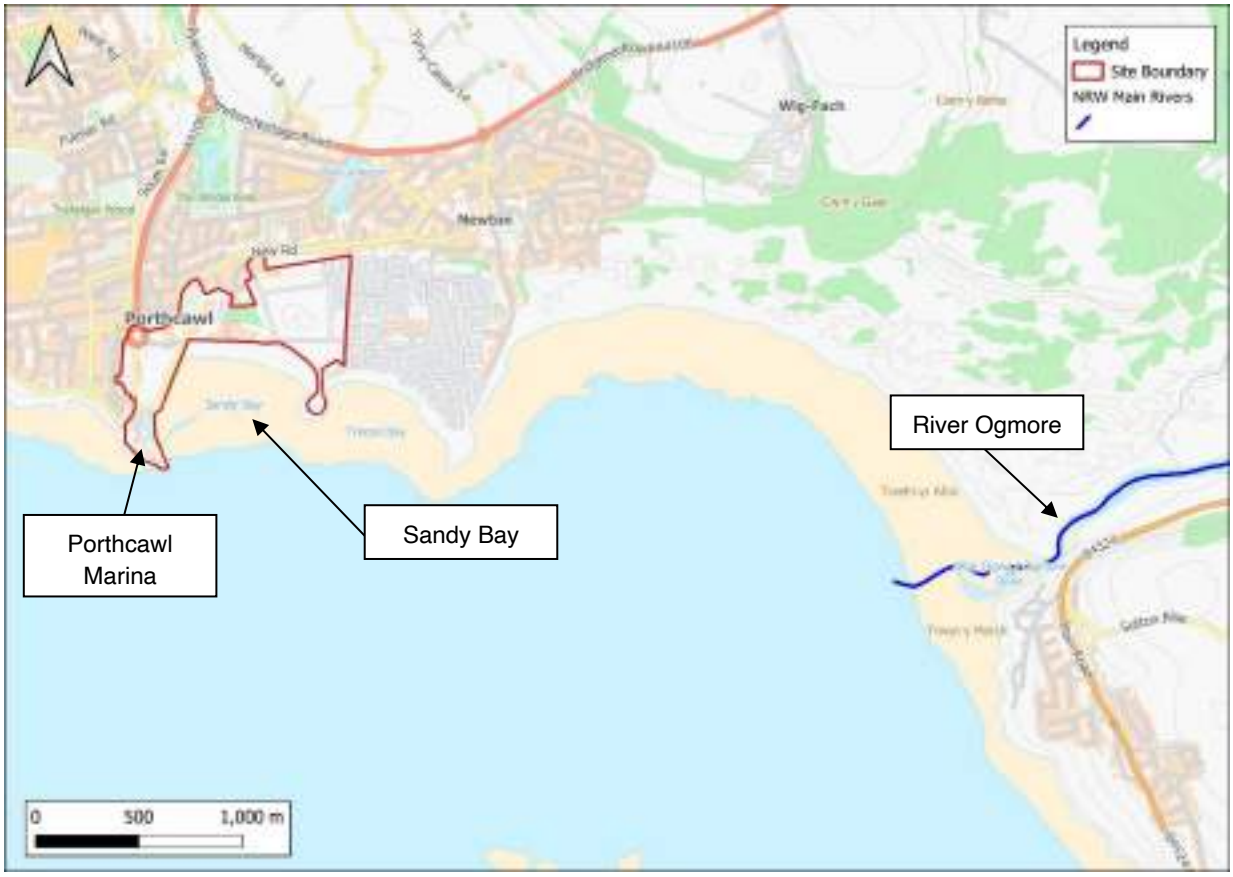

Figure 3: Watercourses Map

2.4 Geology and Hydrogeology

According to British Geological Survey (BGS)[2] geology mapping (accessed October 2025) the site is underlain by bedrock geology comprised of Oxwich Head Limestone Formation in the southwest of the site and Mercia Mudstone Group (marginal Facies) Conglomerate in the northeast of the site. The BGS mapping indicates that there are Superficial Deposits of Marine Beach Deposits, Sand and Blown Sand, present throughout the site.

BGS GeoIndex Onshore[3] data confirms that the site is located within an area designated as a Principal Aquifer for bedrock geology and Secondary A for superficial deposits. Principal Aquifers are defined by rock types that provide significant quantities of water and can support water supply and baseflow to rivers, lakes and wetlands on a strategic scale. They typically have a high permeability, meaning they usually provide a high level of water storage. Secondary A Aquifers also comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.

[2] BGS Geology Viewer (BETA)
[3] BGS GeoIndex Onshore

The site is not located within a Source Protection Zone (SPZ).

Soilscapes[4] mapping shows the site to be located within 'Freely draining slightly acid but base-rich soils' in the west of the site, with the remainder of the site being 'Sand dune soils'.

BGS historic borehole records[5] show that there are nine historic boreholes located within the site boundary ranging from 4.2 – 10.0m in depth. Groundwater was encountered in four of the boreholes, at depths between 4.00 – 6.50m below ground level (m bgl) (BGS Reference: SS87NW13, SS87NW11, SS87NW10 and SS87NW14). The boreholes in which groundwater was found to be present were situated in the west of the site, between The Portway and Eastern Promenade, in proximity to the existing Aldi (located at CF36 5TS).

A Ground Investigation Report was produced by Quantum Geotech in July 2020 (report number Q0281/FR) (**Appendix B**). As part of the ground investigations, nine trial pits were conducted in June 2020, ranging between 3.0m and 3.4m bgl in depth, in which no ground water was encountered. These trial pits were situated in proximity to the Sandy Bay bowl and did not extend into the western parts of the proposed development site. The locations of the trial pits can be found in **Appendix B**.

[4] LandIS - Land Information System - Soilscapes soil types viewer
[5] BGS Borehole Records

3 Proposed Development

The site is currently brownfield land with a mix of existing uses, including Griffin Park, Coney Beach Pleasure Park, Monster Park, Hillsboro Car Park, and Salt Lake. The development proposal includes:

- Up to 980 homes;
- Approximately 20 ha of open space including a series of new significant public open spaces with different offers;
- 2.2 ha of land for educational use;
- Approximately 130,000 square feet of commercial and leisure floorspace including retail uses, a Hotel, Lido and Gym / Wellbeing Centre;
- Enhancement of Porthcawl Harbour environment;
- New coastal defence works;
- A flexible meanwhile leisure use space (approximately 23,500 square feet);
- Approximately 6,500 square feet of flexible community / civic space;
- Provision of up to 600 public parking spaces within the site area;
- New spine road access from the Eastern Promenade to Sandy Bay; and
- Enhancement of the Griffin Park and proposed new facilities including MUGA.

The proposed site layout is presented in **Appendix C**.

The site vulnerability classification according to Figure 4 of TAN15 is 'Highly vulnerable development'. According to paragraph 8.3 of TAN15, the proposals are classed as 'Redevelopment'.

4 Planning Policy

4.1 National Planning Policy

Planning applications are required to adhere to details set forth by the following:

- Planning Policy Wales (PPW) (2021);
- TAN15: Development, flooding and coastal erosion (2025); and
- FCAs: Climate Change Allowances:

NRW defines the fluvial flood zones as follows:

- **Flood Zone 1 (Low Risk)** comprises land assessed as having a ≤0.1% chance of flooding from rivers in any given year (equivalent to the ≥1 in 1,000-year return period flood event), including an allowance for climate change.
- **Flood Zone 2 (Medium Risk)** comprises land assessed as having a 0.1-1% chance of flooding from rivers in any given year (equivalent to the 1 in 1,000 - 1 in 100-year return period flood event), including an allowance for climate change.
- **Flood Zone 3 (High Risk)** comprises land assessed as having a ≥1% chance of flooding from rivers in any given year (equivalent to the ≤1 in 100-year return period flood event), including an allowance for climate change.
- **TAN 15 Defended Zones** comprise areas where flood risk management infrastructure provides a minimum standard of protection against flooding from rivers of 1 in 100-year return period flood event with an allowance for climate change and a freeboard.

4.1.1 TAN15 (2025)

TAN15 provides 'technical guidance which supplements the policies set out in PPW and Future Wales in relation to flooding and coastal erosion' by providing a framework within which 'flood risk arising from rivers, the sea and surface water, and the risk of coastal erosion can be assessed'.

According to Figure 4 of TAN15, the overall proposed development constitutes a 'Highly Vulnerable' development vulnerability classification under 'All residential premises (including hotels, Gypsy and Traveller sites, caravan parks and camping sites)'.

Figure 5 of TAN15 (**Table 2** below) summarises frequency thresholds for different types of development to ensure new development remains flood free during the 1% river flood (i.e. a flood with a 1 in 100 chance of occurring in any year) and the 0.5% flood from the sea (i.e. a flood with a 1 in 200 chance of occurring in any year), plus an allowance for climate change over the lifetime of development.

TAN15 states that these thresholds may be applied with more flexibility in regard to redevelopment, changes of use, conversions and extensions, where the ability to substantially redesign a development is limited.

Table 2. Flood events in which development must be flood-free

Vulnerability Categories		Flood Event Type	
		Rivers	**Sea**
Highly Vulnerable Development	Emergency Services	0.1% + CC	0.1% + CC
	All other types	1% + CC	0.5% + CC
Less Vulnerable Development		1% + CC	0.5% + CC
Water compatible development that may be occupied by people		1% + CC	0.5% + CC

Figure 6 of TAN15 (**Table 3** below) summarises tolerable conditions in an extreme flood event for different types of new development when assessed against the 0.1% extreme flood event, including an allowance for climate change.

Table 3. Tolerable conditions in an extreme flood event

Types of New Development	Maximum Depth of Flooding (mm)	Maximum Velocity of Flood Waters (m/s)
Highly Vulnerable Development	600	0.15
Less Vulnerable Development	600	0.30
Infrastructure associated with highly vulnerable development	600	0.30
Water Compatible Development	600	0.30

4.2 Bridgend County Borough Local Development Plan 2018 – 2033[6]

The Bridgend County Borough Local Development Plan (LDP) was adopted in March 2024. The Planning and Compulsory Purchase Act 2004 requires BCBC to set out its objectives in a LDP for the development and use of land over the plan period, and its policies to implement them.

As shown in the LDP, the proposed development site falls within the Porthcawl Regeneration Growth Area (PLA1). The delivery of new flood defences and redesignation of Porthcawl as a Defended Zone will provide a coincidental opportunity to enable the Porthcawl Waterfront site to provide residential-led growth. The provision of new residential units, including affordable dwellings, will enable the delivery of other vital regeneration requirements.

[6] Bridgend County Borough Local Development Plan 2018 - 2033

The new flood defences being delivered as part of the Flood Defences Scheme, are expected to provide a high standard of protection, significantly reducing the risk of flooding in areas within Flood Zone 3 and respective areas in Flood Zone 2.

4.3 South East Wales Level 1 Strategic Flood Consequence Assessment[7] (2022)

The South East Wales Stage 1 Strategic Flood Consequence Assessment (SFCA) identifies areas at risk of flooding from all sources, including the likely impact of climate change. The study identifies areas at potential high risk from flooding as well as providing details of historical flood events and any details of flood risk management structures or procedures present. The SFCA provides an overview of the planning context in the country and represents available data on flood risk across South East Wales from each of the sources of flooding outlined within TAN15.

The SFCA notes that the site lies within the boundary of the Lavernock Point to St Ann's Head Shoreline Management Plan (SMP). The SFCA advises that the main driver for the relevant policy unit *"is to reduce the risk of coastal erosion and flooding to the developed area of Porthcawl, through a policy of hold the line by maintaining and upgrading defences at Trecco Bay, Sandy Bay, Town Beach and Marine Drive, subject to the future availability of public funding for coastal erosion and flood risk management and private funding for proposed future development at Trecco Bay and Sandy Bay"*.

4.4 Bridgend County Borough Council Strategic Flood Consequence Assessment[8] (2020)

The Bridgend County Borough Council (BCBC) SFCA was published in 2020. The SFCA creates a strategic framework for the consideration of flood risk when making planning decisions, using the most current available information. In the SFCA, Porthcawl is highlighted as a key settlement and regeneration area. Porthcawl is also identified as a location at risk of tidal flooding with two historic events discussed. These events occurred during May 2008, along the Esplanade (80m to the west of the site) and West Drive (600m to the west of the site).

During the production of the SFCA, BCBC have completed detailed tidal modelling of Sandy Bay to understand the future potential for tidal flooding. The SFCA reports that the results of this modelling show that climate change will significantly increase flood risk at Salt Lake car park, which is located within the site boundary, and will increase the flood risk to a broad area of Porthcawl.

The SFCA states that the majority of Porthcawl is likely to have medium or low depths of groundwater (between 0.5m bgl and 5m bgl). Larger areas of groundwater water bodies are predominantly present outside of urban areas. The SFCA confirms that there have been historic incidences of sewer flooding in Porthcawl, but none that have occurred within the site boundary.

[7] South East Wales – Stage 1 SFCA (2022)
[8] Bridgend County Borough Council SFCA (2020)

The SFCA does not report any historical surface water flooding incidents or flooding from artificial sources in proximity to the site. The SFCA advises that the Porthcawl area is generally not susceptible to surface water flooding. It highlights a small area at the southern extent of Salt Lake car park at risk of surface water flooding. This location falls with the proposed development site boundary, however, the SFCA states that this small area is likely due to the topography of the site and it is anticipated that surface water on this site should be easily managed through the use of SuDS techniques.

In response to the tidal model results, BCBC have developed plans for a Flood Defences Scheme divided into two phases, both of which fall within the site boundary. Phase 1 (Eastern Promenade), which is now complete[9], included repair and maintenance to the 182m long Western Breakwater. Phase 2 (Coney Beach), which has not been finalised as of November 2025, will consist of flood and coastal erosion measures along the beach frontage. The SFCA advises that with implementation of the Porthcawl Flood Defences Scheme, it is likely that the Porthcawl Regeneration site can be developed in full compliance with the requirements of TAN15.

4.5 Bridgend County Borough Council Strategic Flood Consequence Assessment Site Screening Update (2022)[10]

This Site Screening Update has been prepared as an addendum to the Bridgend County Borough Council SFCA released in October 2020 (**Section 4.4**). The update was required due to amendments to TAN15. In this Site Screening Update, allocated sites are screened using Red Amber Green (RAG) for various criteria related to flood risk and TAN15. The Porthcawl Regeneration Site receives a RAG assessment rating of 'Amber', which means that a potential significant portion of the site is located in a Flood Zone. This may constrain or limit development of the site. Careful consideration of the justification test and acceptability criteria will be required. It is important to note that the justification test is no longer a requirement of TAN15, following the March 2025 update. The Site Screening Update advises that the proposed flood defence scheme, of which Phase 1 has been completed, should protect the Porthcawl Regeneration Site to a minimum of 0.5% AEP standard of protection, including climate change for 100 years. The Site Screening Update concludes that the Porthcawl Regeneration Site allocation is expected to be safe to develop, subject to a detailed FCA and careful flood resilient design.

4.6 Bridgend Local Flood Risk Management Plan[11] (2016)

The Bridgend Local Flood Risk Management Plan (LFRMP) was published in August 2016 and has been created to highlight hazardous areas and areas at risk of flooding from surface water, rivers, tides, groundwater and reservoirs. It includes the identification of 'Local Flood Risk Investigation Areas' (LFRIA).

[9] Porthcawl's new promenade and flood defence work officially opened
[10] Bridgend County Borough Council SFCA: Site Screening Update (2022)
[11] Bridgend LFRMP (2016)

LFRIA 06 is approximately 184 ha and is situated in the south eastern corner of the Bridgend Boundary to the south of Porthcawl. A small section of LFRIA 06 overlaps with the proposed development site boundary, including Hillsboro Place car park, Griffin Park and Newton Primary School. Within these locations, the LFRMP identifies that two residential properties and one commercial property are predicted to flood for the 1 in 30-year event, using a 200mm threshold.

The LFRMP also indicates that there are surface water flow routes along Poplar Road and Northways, which result in high surface water ponding at the roundabout intersecting New Road and Eastern Promenade. However, historic flooding data does not show any incidents of flooding for the Porthcawl area.

4.7 Climate Change Considerations

Under TAN15 and local planning policy, it must be demonstrated that any proposed development at the site will be safe over its intended lifetime. This could include measures to ensure the development is flood resistant / resilient and that safe access and egress is provided for the following flood events, also known as 'design flood events'.

- 1 in 100-year (1% AEP) fluvial flood event accounting for the future impacts of climate change;
- 1 in 200-year (0.5% AEP) tidal / coastal flood event accounting for the future impacts of climate change;
- 1 in 100-year (1% AEP) pluvial (surface water) event accounting for the future impacts of climate change; and
- 1 in 30-year (3.3% AEP) pluvial (surface water) event accounting for the future impacts of climate change.

Table 4, **Table 5** and **Table 6** provide the latest climate change uplifts for fluvial, surface water flooding, and coastal flooding as per the NRW Climate Change Allowances and FCA guidance[12].

[12] Flood Consequence Assessments: Climate Change (gov.wales)

Table 4. Peak River Flow Allowances for the River Basin Districts across Wales

West Wales	Total potential change anticipated by the 2020s	Total potential change anticipated by the 2050s	Total potential change anticipated by the 2080s
Upper end estimate	25%	40%	75%
Change factor / central estimate	10%	25%	30%
Lower end estimate	5%	10%	15%

Table 5. Change to extreme rainfall intensity (compared to a 1961-1990 baseline)

All of Wales	Total potential change anticipated by the 2020s (2015 – 2039)	Total potential change anticipated by the 2050s (2040 – 2060)	Total potential change anticipated by the 2080s (2070 – 2115)
Upper estimate	10%	20%	40%
Central estimate	5%	10%	20%

Table 6. Estimated mean sea level rise (in metres) for Bridgend County Borough by 2100 and 2120. Allowances are based on RCP8.5 70th and 95th percentiles[13].

Allowance (Percentile)	Mean sea level rise (metres) by 2100 (UKCP18 baseline 1981-2000)	Mean sea level rise (metres) by 2120 (UKCP18 baseline 1981-2000)
70th (Higher Central)	0.84	1.00
90th (Upper End)	1.11	1.32

4.8 Future Wales: The National Plan 2040[14]

Future Wales: The National Plan 2040 is a national development framework, directing development in Wales to 2040. It is a development plan with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, decarbonisation and climate-resilience. Future Wales sets a direction for where investment in infrastructure and development is required. It outlines the challenge of delivering these improvements to the public, private and third sectors.

[13] NRW Flood Consequences Assessments: Climate change allowances (2021)
[14] Upgrade to Future Wales – The National Plan 2040

5 Existing Site Flood Risk

TAN15 requires flood risk from the following sources to be assessed:

- Tidal and fluvial sources (sea and river flooding);
- Surface water sources (flooding resulting from overland flows);
- Groundwater sources;
- Sewer flooding; and
- Artificial sources, canals, reservoirs etc.

Each of these sources are addressed within this section of the report.

5.1 Tidal and Coastal Flood Risk

Due to the site's location, the primary source of flooding relates to coastal and tidal sources from the estuary. A review of NRW's Flood Map for Planning (Seas), shows parts of the site to be located in Flood Zone 2 and Flood Zone 3 (**Figure 4**). Additionally, as shown in **Figure 5**, the west of the site is located within a TAN15 Defended Zone, which highlights areas that are protected by formal flood defences owned and maintained by a Risk Management Authority.

Figure 4: NRW's Flood Map for Planning (Seas)

Figure 5: TAN15 Defended Zones

As part of the Flood Map for Planning, NRW have a Flood Defence Location dataset (**Figure 6**). The southern boundary of the site meets Sandy Bay, a southwest facing coastal embayment. Within the site boundary, there are various flood defences which are described below.

In the west of the development site, is an 182m Western Breakwater that significantly influences coastal risk within Sandy Bay. There is also a 400m long stretch of Eastern Promenade which consists of a masonry sea wall and parapet that is set back between 5 – 10m from the wall. According to the Flood Inundation Modelling Report produced by Ove Arup and Partners Ltd (Arup) in 2017, Eastern Promenade is elevated approximately 5m above the beach level, depending on the sand level (**Appendix D**). According to this same report, it is understood that the standard of protection for existing defences is up to the 1 in 200-year event.

The central section of Sandy Bay adjacent to Coney Beach Pleasure Park contains various private sea walls, revetments and steep stepped access points. However, the Coney Beach Pleasure Park flood defences are not indicated in the NRW dataset in **Figure 6**. The ground level in the south of the fairground is approximately 3.5m above the adjacent beach level.

The eastern end of Sandy Bay is bound by sand dunes and Rhych Point, both of which are indicated on **Figure 6**. The elevation of the sand dunes is approximately 4m above the beach level and Rhych Point, which extends approximately 180m south of the dunes, has an elevation of 8m.

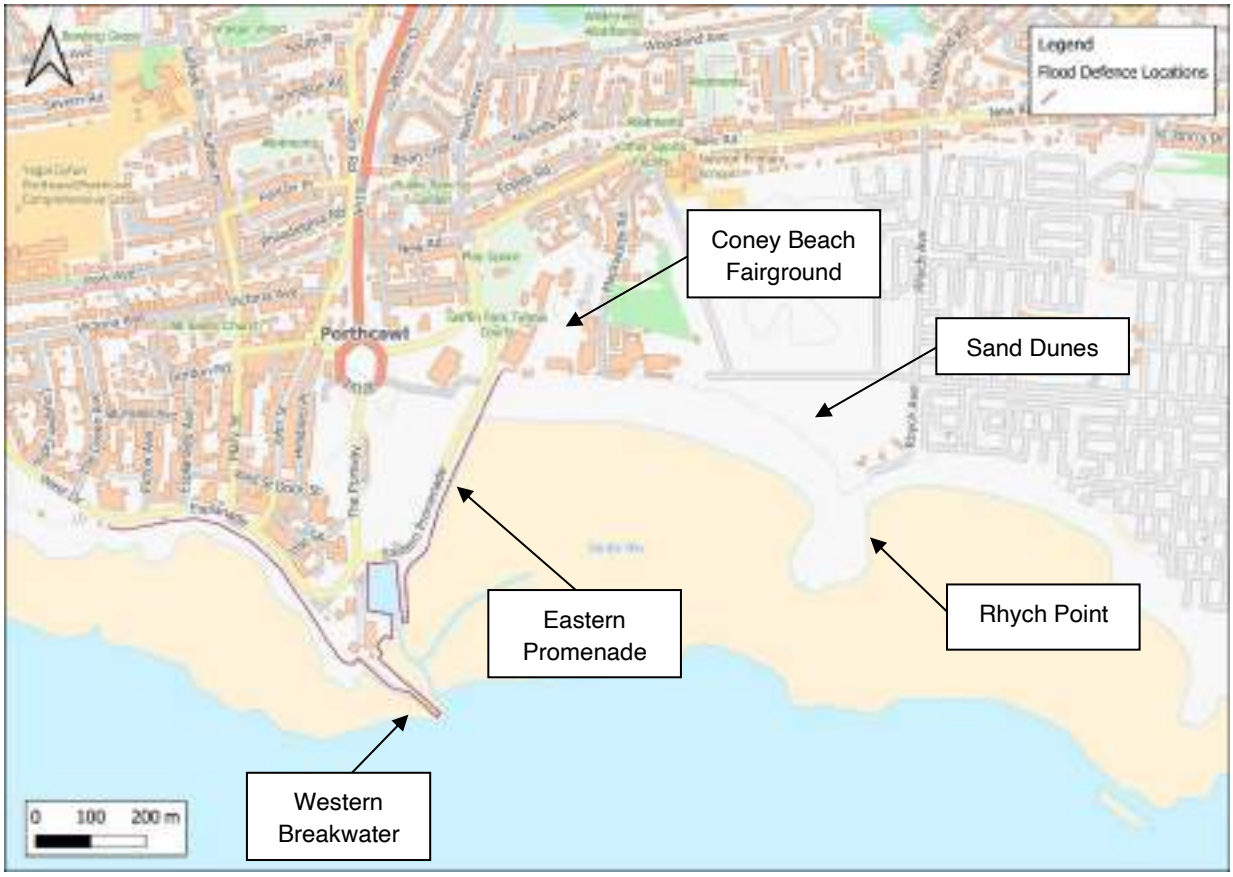

Figure 6: NRW's Flood Defences dataset

According to the NRW Recorded Flood Extents, the site lies outside of the extents of previous tidal flood events. The closest recorded events occurred during May 2008, along the Esplanade (80m to the west of the site) and West Drive (600m to the west of the site) (**Figure 7**).

Figure 7: NRW's Recorded Flood Extents

5.1.1 Breach Scenario

As per NRW Guidance Note 43[15], the likelihood of a breach of defences that provide any degree of protection to a development site must always be assessed and can be influenced by defence type, location, condition, ownership and predicted loading. If it is considered that the failure of a defence is so unlikely it does not need to be assessed, then this must be supported by appropriate evidence.

The Flood Inundation Modelling Report produced by Arup in 2017 formed part of the Sandy Bay and Eastern Promenade Project Appraisal (**Appendix D**). The aim of this report was to assess the flood risk from tidal / coastal overtopping along Sandy Bay and Eastern Promenade. Model simulations were run for 2018 (present day) and 2118 (future scenario). The scenarios modelled include breaches at Mackworth Road, four separate sections of the Eastern Promenade parapet wall, and a 'Do Nothing' scenario in which all defences (Western Breakwater, Eastern Promenade, and Mackworth Road) are assumed to fail. Although the baseline model, which underpins the breach modelling is now considered to be out of date, the results can still provide valuable insight.

[15] NRW Guidance Note 43: Modelling blockage and breach scenarios

The modelled breach at Mackworth Road showed no significant increase in flood extent or flood depth compared to a scenario without breach. The modelled breaches along the Eastern Promenade showed only a slight increase in flood extent and depth in 2018 but a significant increase for 2118. Model results for the 'Do Nothing' option showed flooding to the junction between A4108 and A4106.

As outlined in **Section 4.4**, the Western Breakwater has recently been repaired and upgraded. Along the Eastern Promenade, if overtopping of the sea wall did occur, the secondary parapet would work to contain the water. Due to the nature of the proposed development, changes are proposed to existing ground levels. The Salt Lake area is proposed to be raised approximately 1.5m above existing ground levels, increasing its level of protection.

The development proposal incorporates several flood resilience and improved coastal protection measures in the Coney Beach area. These include a terraced revetment structure along the existing shoreline west of Mackworth Road, localised ground raising in the same area, a flood defence ramp at Mackworth Road, and rock armour erosion protection to the east of Mackworth Road. To the east of the site, the sand dunes will be retained and enhanced.

5.2 Updated Sandy Bay Modelling

As part of the evidence base for the Porthcawl Waterfront Regeneration project, Arup updated the baseline modelling for Sandy Bay and conducted post development modelling in October 2025 (report reference 309314-ARP-XX-XX-RP-MO-001) (**Appendix E**). The modelling incorporated sea level rise allowances for 'Higher Central' (70th percentile) and 'Upper End' (95th percentile), with simulations run for the years 2026 (present day) and 2126 (future scenarios). According to the NRW guidance on Climate Change Allowances for Flood Consequence Assessments[16], updated September 2021, development proposals should be assessed against the relevant regional 70th percentile to inform design levels as a minimum. An assessment should also be made against the 95th percentile to inform mitigation measures, access and egress routes and emergency evacuation plans (refer to **Section 7.2**).

5.2.1 Baseline Results

Figure 8 shows the maximum flood depth results for the design event (1 in 200-year with climate change) with the higher central allowance (70th percentile). The model results show flooding predicted in four main areas of the site. These are Salt Lake, Porthcawl Marina, Griffin Park and Mackworth Road.

The model results for the 1 in 200-year 2126 storm event show that water overspills from the northeast corner of Porthcawl Marina and travels northward across Eastern Promenade into Salt Lake. There is flooding predicted along the Eastern Promenade walkway, with maximum flood depths of approximately 20cm. For the low-lying areas north of Porthcawl Marina, the maximum flood depths are approximately 60cm. The flooding also extends further north of Sandy Bay following two main flow paths. One of these flow paths follows the Eastern Promenade and New Road with flooding extending as far as Nicholls Avenue for the 0.5% AEP event. The second key flow path follows the route of Mackworth Road. The

[16] Flood Consequences Assessments: Climate change allowances

maximum flood depths along the Eastern Promenade and New Road flow path are of approximately 45cm whereas the maximum flood depths along Mackworth Road are of approximately 80cm in the 1 in 200-year 2126 storm event. Within Griffin Park, flood levels remain below 53cm, with the deepest levels of flooding predicted within the tennis courts and bowling greens due to topographical lows.

Figure 8: Baseline maximum flood depth 1 in 200-year event with higher central allowance for 2126

Figure 9 displays the baseline model results for the extreme event (1 in 1000-year with climate change), with the higher central allowance (70th percentile). In this event, the maximum flood depths along the Eastern Promenade walkway increase to approximately 70cm. For the low-lying areas north of Porthcawl Marina, the maximum flood depths are approximately 190cm. The flow path along Eastern Promenade and New Road extends further north, reaching Woodland Avenue and The Wilderness (approximately 500m to the north of the site). The maximum flood depth along this flow path, increases to 50cm. During the 1 in 1000-year 2126 storm event, maximum flood depths along Mackworth Road reach approximately 90 cm. For this event, flooding is shown to extend eastward beyond Mackworth Road, reaching Hi Tide. Within Griffin Park, flood depths increase to around 59 cm.

Figure 9: Baseline maximum flood depth 1 in 1000-year event with higher central allowance for 2126

The results in **Figure 10** indicate that the maximum flood velocity in the extreme event remains below 0.75m/s throughout most of the site. The exceptions to this are the Porthcawl Marina, Coney Beach Pleasure Park frontage, Eastern Promenade adjacent to Griffin Park and Mackworth Road.

Figure 10: Baseline maximum flood velocity 1 in 1000-year event with higher central allowance for 2126

Considering the above, the existing site is considered to be at a 'medium to high' risk of flooding from tidal sources. **Section 6** discusses flood mitigation, resistance and resilience. **Section 7** presents the post-development results.

5.3 Fluvial Flood Risk

According to NRW Flood Map for Planning (Rivers) (**Figure 11**), the site is located within Flood Zone 1 (Low Probability) with the closest areas of Flood Zone 2 and Flood Zone 3 located approximately 2.8km to the northwest of the site, associated with an unnamed watercourse. There are also areas of Flood Zone 2 and Flood Zone 3 located 4km to the east of the site, associated with the Ogmore River.

According to the NRW Recorded Flood Extents, the site lies outside of the extents of previous fluvial flood events. Additionally, there is no evidence in the SFCA to suggest that the site is at risk of fluvial flooding.

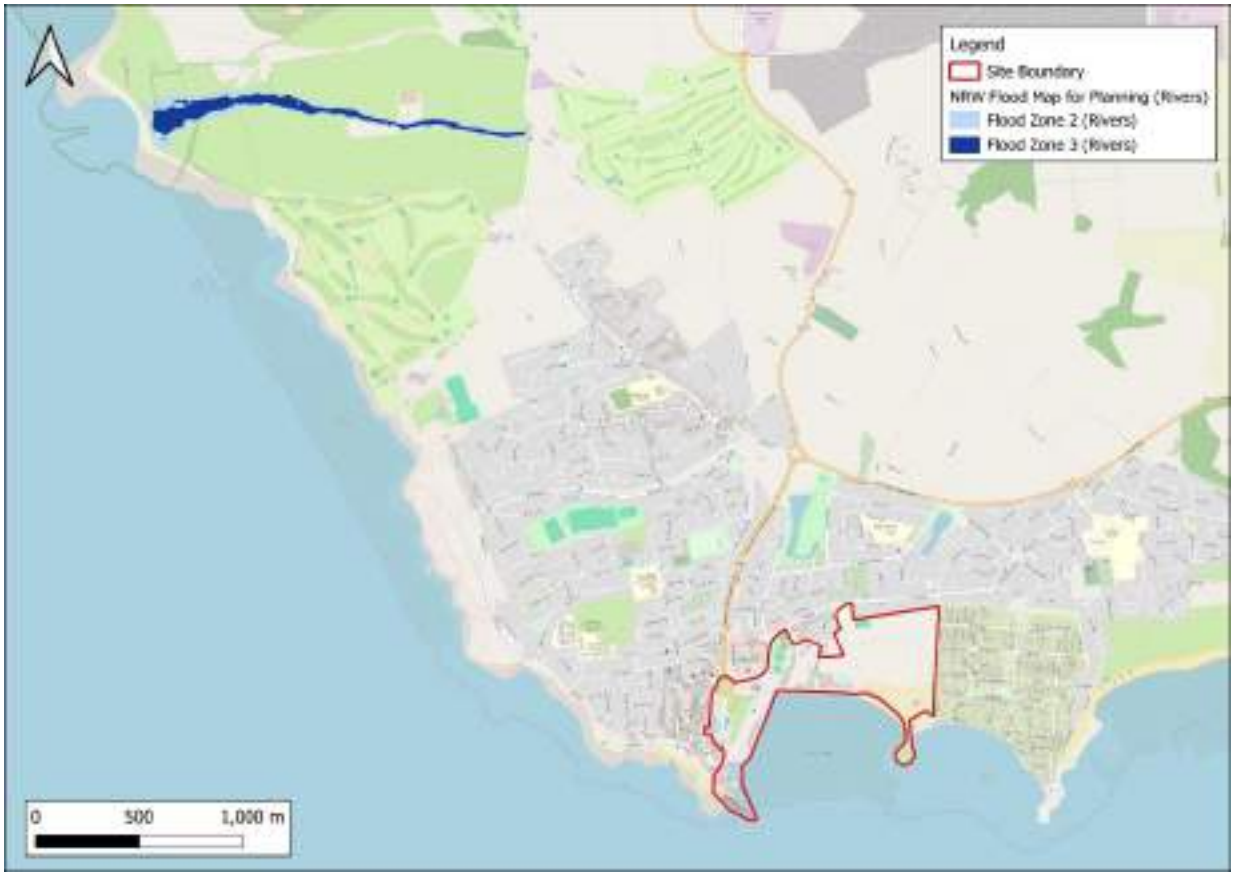

Figure 11: NRW's Flood Map for Planning (Rivers)

Therefore, the site is considered to be at a 'low' risk of flooding from fluvial sources.

5.4 Surface Water Flood Risk

Surface water (pluvial) flooding is caused by rainfall levels exceeding the natural infiltration properties of the surrounding soils. Flooding can also occur owing to the absence of a natural method of drainage such as watercourses or ditches, or where soil infiltration rates are low. Flooding often results in ponding of water at low points or when surface water flow routes are blocked by an obstruction.

The NRW Flood Map for Planning, shows that most of site is located within Flood Zone 1 in relation to Surface Water and Small Watercourses (**Figure 12**). However, as shown in **Figure 12,** there are small areas of Flood Zone 3 located in Hillsboro Place Car Park, Salt Lake car park, along The Portway and on Dock Street. Additionally, there are small, isolated areas of Flood Zone 2 in Griffin Park and the Sandy Bay bowl green space (**Figure 12**). The NRW Flood Map for Planning (Surface Water and Small Watercourses) dataset is inclusive of the effects of climate change.

The areas of Flood Zone 2 and Flood Zone 3 (Surface Water and Small Watercourses) are a result of topographical lows. Notably, there are no overland flow routes entering the site from surrounding land that would present a risk of flooding to the site.

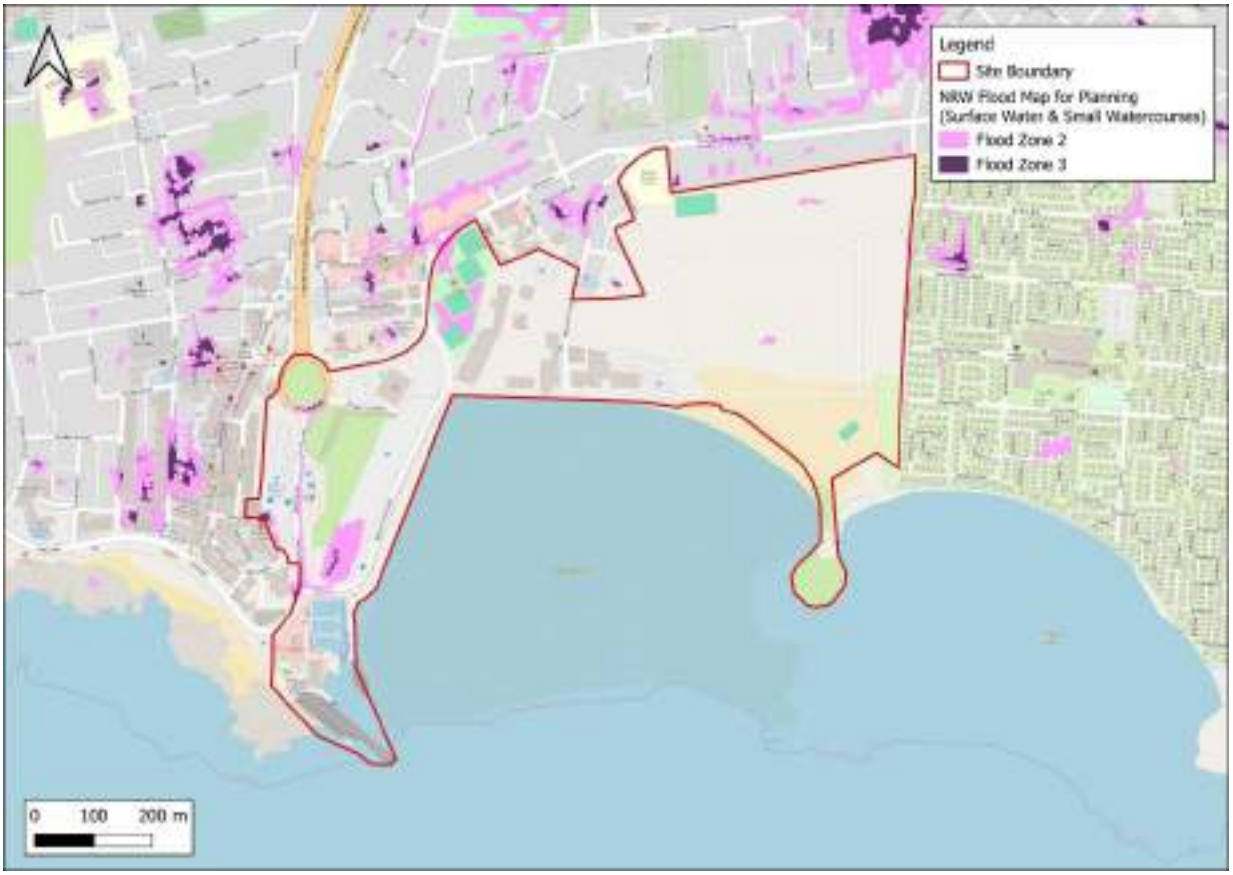

Figure 12: NRW's Long Term Flood Risk Map (Surface Water and Small Watercourses)

A Drainage Statement Report has been developed to ensure that the development does not exacerbate surface water flood risk on and off-site (document reference 32485-STN-XX-XX-RP-C-1001 P01) (**Appendix G**). SuDS are a form of flood resistance, and a variety of measures are proposed throughout the site. Surface water discharge from the Sandy Bay parcel are anticipated to be dealt with by swales, infiltration basins and conventional pipework. The proposed Sustainable Drainage Systems (SuDS) will be designed in accordance with the Welsh Statutory SuDS Standards and approved by the local authorities acting in its SuDS Approving Body (SAB) role.

As such, given the low risk identified by the NRW mapping, the site is concluded to be at 'low' risk of surface water flooding.

5.5 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a sufficient rise in groundwater level where the water table intersects the ground surface and inundates low lying land. Periods of prolonged rainfall may also be a cause of groundwater flooding, with aquifers and soils becoming saturated.

As the site is within an area designated by BGS as a Principal Aquifer for bedrock geology and Secondary A for superficial deposits, there is potential for the ground below the site to have high permeability and a high level of water storage. The site is not located within a Source Protection Zone (SPZ).

Given the extensive area covered by the development site, it is likely that groundwater conditions will vary spatially across different parts of the site. This variability may be influenced by factors such as localised geology, historical land use, and topography.

BGS historic borehole records[17] show that there are nine historic boreholes located within the site boundary ranging from 4.2m to 10.0m in depth. Groundwater was encountered in four of the boreholes, at depths between 4.00m and 6.50m bgl (BGS Reference: SS87NW13, SS87NW11, SS87NW10 and SS87NW14). The boreholes in which groundwater was found to be present are situated between The Portway and Eastern Promenade, in proximity to the current Aldi site (located at CF36 5TS).

In the eastern part of the site, the ground investigation undertaken by Quantum Geotech in June 2020 consisting of nine trial pits to a depth of 3.4m bgl did not encounter any groundwater in the Sandy Bay Bowl area (**Appendix B**).

Further ground investigations were undertaken in February 2021 by Groundtech Consulting as part of the Aldi development that falls within the western part of the site boundary (planning reference P/21/835/FUL)[18]. In these investigations, groundwater was encountered in BH2, BH3, BH4 and WS01 between depths of 4.5m and 7.5m bgl.

Considering the above, the site is considered to be at 'low' risk of groundwater flooding.

5.6 Sewer Flooding

Flooding can occur owing to the failure of existing foul or surface water drainage infrastructure. If flows within the drainage system exceed the designed capacity or foreign matter causes blockages, overflow to the surface can occur, leading to flooding.

Dwr Cymru Welsh Water (DCWW) is identified as the entity responsible for sewer infrastructure across the study area. According to a November 2020 Drainage Strategy Report produced by Redstart, there are several public foul sewers under DCWW ownership, most notably within the Hillsboro Place Car Park, adjacent to the pavilion in Griffin Park, through Mackworth Road and along the western and northern perimeter of the Sandy Bay Caravan Park. Additionally, there is a 400mm diameter public foul rising main that crosses the Salt Lake Car Park. The rising main originates from the Irongate Sewerage Pumping Station located off West Drive. A 225m diameter public surface water sewer travels in a southerly direction through Mackworth Road and eventually discharges into a 600mm drain under BCBC ownership.

In addition, various drainage assets within the site boundary are under BCBC ownership including highway drainage (primarily along The Portway), a 1100mm diameter drain conveying flows from The Wilderness Lakes 600m to the north of the site which eventually discharges to the harbour, and the 600mm drain that crosses Salt Lake Car Park where it receives a connection from the public surface water sewer system.

[17] BGS Borehole Records
[18] BCBC Planning Register P/21/835/FUL

There are large areas within the site boundary that are currently being served by private drainage systems, including the Sandy Bay Caravan Park and Coney Beach Amusement Park. It is assumed that the majority of the private network in these locations will be abandoned and replaced with new systems serving the development site. The above-mentioned assets are indicated on the Existing Drainage and Sewerage Plan (drawing number GC3432-RED-73-XX-SK-D-0002-P01), which has been provided in **Appendix F**.

Conversations with DCWW and BCBC as the LLFA have been on-going regarding existing assets and appropriate drainage strategies for the regeneration site. A Drainage Statement Report (document reference 32485-STN-XX-XX-RP-C-1001 P01) has been provided in **Appendix G**. Diversions of existing sewers / drains will be required to accommodate the flood defence revetment and western plots within Lake. It is anticipated that surface water flows from the Salt Lake parcel will be permitted to discharge freely either into the harbour (via a new drainage system) or into the wilderness culvert (which currently discharges into the harbour). Surface water flows from the Coney Beach parcel will discharge into the harbour to the south of Salt Lake via a new drainage system.

Therefore, the site is considered to be at a 'low' risk of sewer flooding.

5.7 Artificial Sources

Failures and overtopping of reservoirs and navigable water bodies, and failure of water mains, constitute the primary means of flooding from artificial sources.

NRW Flood Risk from Reservoirs mapping shows the site to lie outside of the extents of potential reservoir flooding. NRW also state that reservoir flooding is extremely unlikely to happen. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England and Wales, the NRW ensure that reservoirs are inspected regularly, and essential safety work is carried out.

Additionally, there is no indication within the SFCA that the site is at an enhanced risk of flooding from artificial sources. Considering the probability of catastrophic reservoir failure is considered to be extremely low, the risk of artificial flooding to the site is considered to be low.

5.8 Confirmation of Design Flood Event and Design Flood Level

The dominant flood risk mechanism to the site is from tidal and coastal sources. As outlined in **Section 4.1**, under TAN15 and local planning policy, it must be demonstrated that any proposed development at the site will be safe over its intended lifetime for the design flood event. The appropriate design flood event for this site is the 1 in 200-year (0.5% AEP) tidal / coastal event accounting for the future impacts of climate change (higher central allowance).

The model results have shown flooding predicted in four main areas of the site. These are Salt Lake, Porthcawl Marina, Griffin Park and Mackworth Road. Of these locations, only Salt Lake and the western side of Mackworth Road are proposed for new commercial and residential buildings. Therefore, the design flood level for each relevant location is as follows:

- Salt Lake 7.50m AOD

- West of Mackworth Road 9.71m AOD (on seafront)
- West of Mackworth Road 9.42m AOD (set back from seafront)
- East of Mackworth Road 8.53m AOD

5.9 Existing Flood Risk Summary

Each flood risk source and its associated risk level is provided in **Table 7**. It has also been specified which specific sources require mitigation measures, which will be discussed in **Section 6**.

Table 7. Existing Site Risk Summary

Flood Risk Source	Existing Site Risk Level	Mitigation Required
Tidal	High	Yes – See **Section 6**
Fluvial	Low	No
Surface Water	Low	No
Groundwater	Low	No
Sewers	Low	No
Artificial Sources	Low	No

6 Flood Mitigation, Resistance and Resilience

The following flood risk resistance and resilience measures have been recommended in response to the risks outlined in **Section 5**. While the level of flood protection provided to the site by the existing flood defence network is expected to be maintained or upgraded, residual risk associated with defence overtopping, breach or storm events that exceed the standard of protection remains. The following mitigation measures are recommended to reduce the residual risk, and to ensure that the proposed development will be safe for its lifetime, without increasing flood risk elsewhere.

6.1 Site Layout and Sequential Approach

Importantly, as outlined in **Section 4.2 to Section 4.5**, Porthcawl Regeneration Area is a key strategic are for redevelopment and the site has been allocated in the LDP and screened in the SFCA. The LDP was prepared with constraints, including flood risk, in mind. As the proposal is for redevelopment of an existing site, not new development of a greenfield site, there is opportunity for environmental (including flood risk) improvements beyond the existing baseline.

The proposed site layout has been developed in accordance with the sequential approach to flood risk management. The southwestern corner of the site surrounding Salt Lake and Porthcawl Marina, has been identified as higher flood risk. As per the proposed site plan in **Appendix C**, this area is designated for a mix of leisure uses, community space and a hotel, with basement carparking beneath. All of which are 'Less Vulnerable' as per Figure 4 of TAN 15, with the exception of the hotel. Residential use ('More Vulnerable' as per TAN15) is proposed for the upper levels. Griffin Park is also to remain as leisure use, with tennis courts, a bowling green and a MUGA. All of which are considered 'Less Vulnerable'.

Mackworth Road is allocated for a mixture of residential and commercial uses. On the eastern side of Mackworth Road, the Buccaneer Building (commercial use) and residential properties are to remain as is. On the western side of Mackworth Road, a residential block is proposed with under croft parking beneath. To the north of this block, split level townhouses are proposed with a finished floor level of 10.50m AOD.

In summary, the site layout demonstrates a clear application of the sequential approach, ensuring that 'More Vulnerable' uses are directed to areas of lower flood risk and that appropriate mitigation measures are incorporated throughout the development.

6.2 Finished Floor Levels

It is recommended that finished floor levels (FFLs) are set 600mm at minimum above the estimated flood levels. **Appendix H** displays the Proposed Engineering Levels for the site. This confirms that the proposed FFLs for buildings in the Salt Lake area are between 8.50m AOD and 8.80m AOD, which is above the recommended 8.10m AOD.

Although Griffin Park is identified as an area of higher flood risk, it is designated for leisure use (combination of sports pitches and play areas) and therefore does not require FFLs. **Appendix H** shows a building located south of the sports pavilion with an FFL of 5.60m AOD; however, this structure is a pumping station with a below-ground tank.

On the western side of Mackworth Road, **Appendix H** confirms that the proposed FFL for the split-level townhouses is 10.50m AOD, above the recommended level of 10.02m AOD. These townhouses include a lower ground floor; however, this level is not proposed for sleeping accommodation. The recommended FFL for the residential block on the seafront is 10.31m AOD. This block is proposed for under croft parking, with sleeping accommodation on upper levels.

On the eastern side of Mackworth Road, the Buccaneer Building, Hi-Tide and residential properties are to be retained as is, with existing floor levels. However, the flooding predicted in the post development scenario at the Buccaneer Building could potentially be mitigated by raising the FFLs in the future, dependant on future development aspirations. The existing residential properties on the east of Mackworth Road are located to the north of the Buccaneer Building, set back from the coast. These properties are already elevated well above the road level, offering inherent flood protection.

6.3 Flood Resistance and Resilience

The development proposal includes multiple upgrades to existing infrastructure that improve the flood resilience of the site. For example, a new stepped sea wall revetment is proposed along the existing Coney Beach Pleasure Park frontage, to a level of 10.35m AOD.

To ensure the development is appropriately resilient to coastal and tidal flooding, it is recommended that flood resilient construction techniques are incorporated into the buildings, in addition to raising FFLs 600mm above the predicted flood level. The CIRIA Code of Practice for Property Flood Resilience (C790F)[19] provides guidance on measures that reduce the risks to people and property enabling households and businesses to reduce flood damage, speed up recovery and reoccupation. The following standards are recommended to be followed:

- The installation and retrofit of resistance measures - British Standard 851188-1:2019+A1:2021[20];
- Speeding the recovery of buildings after a flood - British Standard 85500:2015[21]; and
- Dealing with and preventing water from the surrounding ground entering below ground structures such as basements - British Standard 8102:2022[22].

6.4 Flood Warning

This spatial Flood Warning Areas dataset are geographical areas where NRW expect flooding to occur and where NRW provide a Flood Warning Service. Flood Warning Areas generally contain properties that are expected to flood from rivers or the sea. The site does not fall within a NRW Flood Warning Area[23]. However, the site is adjacent to the 'Swansea Bay and the Gower peninsula coast between

[19] CIRIA Code of Practice for Property Flood Resilience
[20] Flood resistance products - Building products. Specification
[21] Flood resistant and resilient construction. Guide to improving the flood performance of buildings
[22] Protection of below ground structures against water ingress. Code of practice
[23] Data Map Wales – Flood Warning Areas

Llangennith and Llantwit Major' Flood Alert area[24]. Flood Alert Areas are geographical areas where it is possible for flooding to occur from rivers or the sea.

Tidal flooding is easier to predict than other forms because the primary cause, the gravitational pull of the moon and sun, is well understood. In contrast, other types of flooding, such as fluvial or surface water flooding, are triggered by more complex weather patterns that are harder to forecast and can occur more rapidly. As a result, the NRW Flood Warning Service is expected to provide adequate advance notice to allow site occupants to evacuate safely or seek refuge before flooding occurs. Safe access and egress are covered in **Section 7.2.**

[24] Data Map Wales – Flood Alert Areas

7 Post-Development Scenario

7.1.1 Raw Post Development Results

Figure 13 shows the model results for the post development scenario in the 1 in 200-year with higher central allowance flood event. **Figure 14** shows the post-development scenario model results for the 1 in 1000-year with higher central allowance flood event. For figures showing a comparison of baseline and post development flood depths and extents for a range of storm events, refer to **Appendix E**.

When compared to the baseline model results, the maximum flood extents and depths are significantly reduced in the post development scenario, due to reduced overtopping at Sandy Bay. As per TAN15, the development must remain free from flooding for the 1 in 200-year event plus climate change, which is the 'design event'. The Arup modelling investigation has concluded the proposed new buildings will not be flooded, except for the basement level of one of the new buildings located in Salt Lake, immediately north of the Porthcawl Marina (**Appendix E**). The proposed use of this basement level is a car park. The model results show that flood water enters this building from the 6m-wide car park entrance which is at ground level and floods the basement to a maximum depth of 0.25m for the 1 in 200-year event with climate change (**Figure 13**), and 3.01m for the 1 in 1000-year flood event (**Figure 14**). The existing minimum road level on Eastern Promenade is 7.3m AOD and the maximum level of flood water on the road in the baseline event is 7.5m AOD (for the 1 in 200-year with higher central allowance). To mitigate the flooding at this location, it is proposed to raise the minimum external levels surrounding the basement entrance to 7.9m AOD from approximately 7.3m AOD. This increase of 600mm is considered sufficient to prevent water ingress in the 1 in 200-year 2126 storm event **and** to minimise water ingress in the 1 in 1000-year 2126 storm event. For the 1 in 1000-year 2126 storm (the extreme event), this change would theoretically reduce the depth of flooding within the basement carpark to below the 600mm tolerable threshold (at approximately 300mm). This theoretical approach uses the hydrograph of flows entering the basement car park from Eastern Promenade, as well as the stage time series on Eastern Promenade, to identify a suitable spot level for the car park entrance. This increase in ground level is represented in the Engineering Levels Plan (**Appendix H**). However, it has not been represented in the hydraulic model at this stage, which uses 7.3m AOD, as this change was made following the completion of the modelling and is one of the key recommendations made off the back of the hydraulic modelling completed by Arup.

Additionally, the proposed scheme results in increased flooding to the Buccaneer building (within the site boundary), east of Mackworth Road. This occurs to a maximum depth of 0.53m for the 1 in 200-year flood event (**Figure 13**) and 0.64m for the 1 in 1000-year flood event (**Figure 14**). As outlined in **Appendix E,** the new flooding to the Buccaneer building can be attributed to changes in the ground profile at the Sandy Bay frontage and southern end of Mackworth Road. In the post-development scenario, the Sandy Bay frontage and southern end of Mackworth Road are raised to a level higher than the existing floor level of the Buccaneer building (which is to remain as existing). As a result, flows from overtopping, although smaller than in the baseline, can travel down the landward slope to reach the Buccaneer building. However, it should be noted that the model does not include subsurface drainage which should mitigate this.

Figure 13: Post development maximum flood depth 1 in 200-year with higher central allowance for 2126

TAN15 Extreme Event "Tolerable" Conditions

As per TAN15, in the extreme event, flooding must remain below 600mm, and maximum flood velocity should remain below 0.15m/s in the extreme event (1 in 1000-year). The results in **Figure 14** indicate that the 600mm depth threshold is exceeded in the low-lying areas surrounding Porthcawl Marina, in Salt Lake and on Mackworth Road. Flood depths in Salt Lake and Mackworth have been addressed above and will be mitigated via ground raising and drainage, which are not represented in the model results. The section of the site, surrounding Porthcawl Marina, south of Eastern Promenade is to remain as existing.

Figure 14: Post development maximum flood depth 1 in 1000-year with higher central allowance for 2126

Figure 15 shows that, in the post-development scenario, maximum flood velocities during the extreme 1 in 1000-year event remain below the tolerable threshold of 0.15 m/s across most of the site. Exceptions include the Porthcawl Marina (including part of Eastern Promenade) and the southern end of Mackworth Road. Locations where the threshold is exceeded are primarily limited to roads rather than residential or commercial properties. This shows an improvement compared to the baseline presented in **Figure 10**, where maximum flood velocity remains below 0.75m/s throughout most of the site.

If tolerable condition thresholds were applied to redevelopment proposals without flexibility, key areas could be excluded from regeneration. Additionally, as discussed in **Section 4.2**, the site is allocated for regeneration in the LDP, highlighting its strategic importance.

Figure 15: Post development maximum flood velocity 1 in 1000-year with higher central allowance for 2126

7.1.2 Comparison Between Baseline and Post Development

Figure 16 and **Figure 17** present a comparison between the 1 in 200-year event with higher central allowance for 2126 between the baseline and post-development scenarios. Notably, **Figure 16** demonstrates that the development proposal shows benefit to flood extents beyond the site boundary. A reduction in flood extents can be seen on Northways, New Road, Poplar Road and Nicholls Avenue, north of the site boundary.

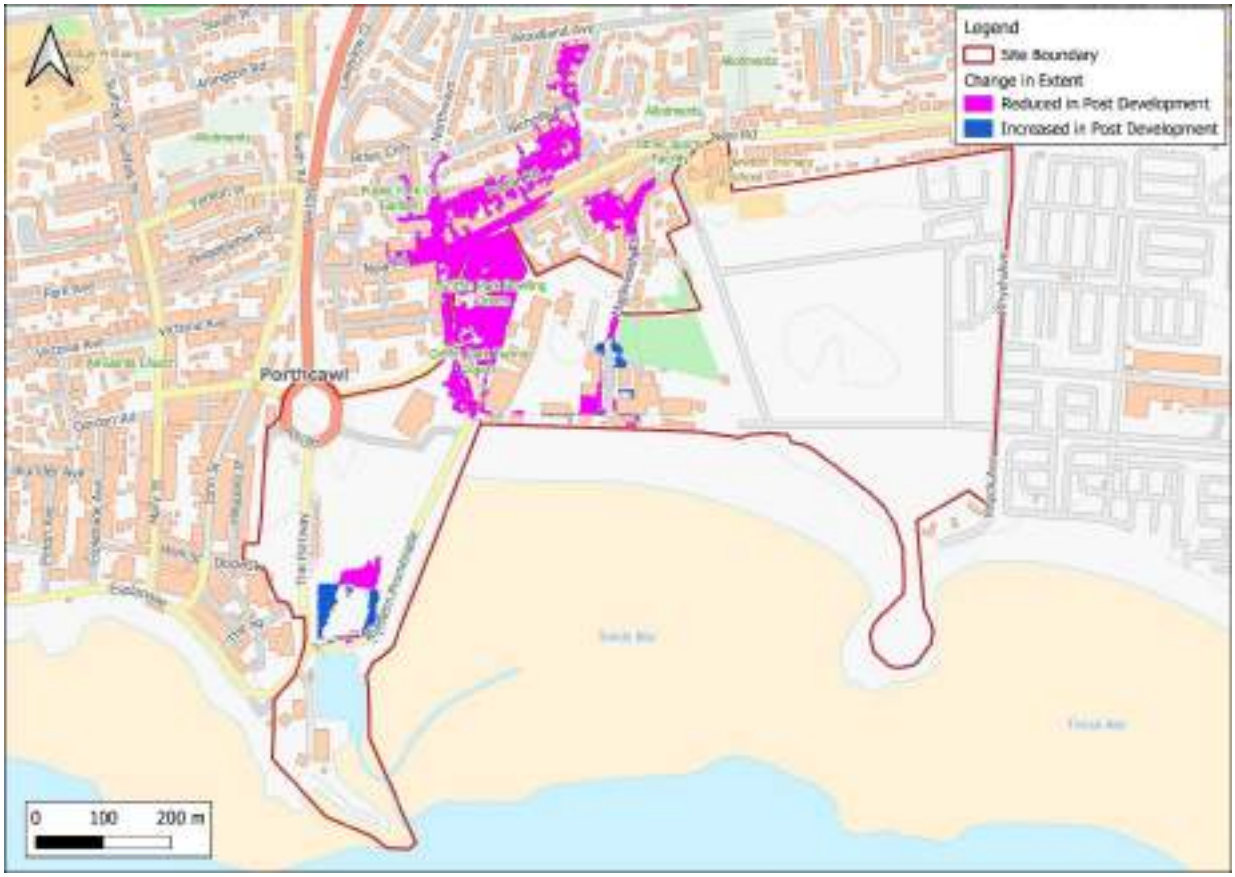

Figure 16: Comparison between the 1 in 200-year event with higher central allowance for 2126 baseline and post development scenario flood extents

Figure 17: Comparison between the 1 in 200-year event with higher central allowance for 2126 baseline and post development scenario flood depths

7.2 Access and Egress

For the assessment of access and egress, the 95th percentile (upper end allowance) has been used (see **Figure 18** and **Figure 19** below). Flood depths below 30cm are generally considered safe for vehicles. There are four key access / egress locations to the site. These are considered to be:

- A4106 in the west of the site
- Eastern Promenade in the west of the site
- Mackworth Road in the centre of the site
- Ryhch Avenue on the eastern site boundary

In the 1 in 200-year event with the upper end allowance for the post-development scenario (**Figure 18**), the A4106 and Rhych Avenue remain flood free, providing safe access / egress to the west and east of the site. The north of Eastern Promenade is predicted to flood to a maximum depth of 8cm. The north of Mackworth Road is predicted to remain flood free. The south of Mackworth Road is shown to flood to a maximum depth of 150cm.

Figure 18: Post development maximum flood depth 1 in 200-year event with upper end allowance for 2126

For the 1 in 1000-year with climate change event (extreme event) (**Figure 19**), the A4106 and Rhych Avenue remain flood free, providing safe access / egress to the west and east of the site. The north of Eastern Promenade is predicted to flood to a maximum depth of 13cm. The south of Mackworth Road is predicted to flood to a maximum of 160cm and the north of Mackworth Road remains flood free. In the southwestern corner of the site, Eastern Promenade is shown to flood to a maximum depth of 118cm.

Figure 19: Post development maximum flood depth 1 in 1000-year event with upper end allowance for 2126

Based on the results in **Figure 18** and **Figure 19**, emergency services should be able to access most of the site during a flood event, using flood-free routes and roads with minimal flood depths. Given the nature of the proposed development, the majority of buildings within the site will incorporate upper floors that can serve as safe refuge areas during a flood event. Furthermore, the site is located adjacent to the 'Swansea Bay and the Gower Peninsula Coast between Llangennith and Llantwit Major' Flood Alert area[25], which benefits from established flood forecasting and warning systems. As tidal flooding is generally more predictable than other sources such as surface water or flash flooding, occupants are likely to receive timely alerts regarding elevated tidal levels. Provided that residents and site users are

[25] Data Map Wales – Flood Alert Areas

registered to receive Flood Alerts, there should be adequate time to either evacuate via designated safe access and egress routes or relocate to upper levels within buildings, thereby reducing risk to life.

8 Conclusions

Stantec Hydrock Ltd have been commissioned by The Urbanists to undertake a Flood Consequences Assessment (FCA), for the proposed development at the Porthcawl Waterfront.

The flood risk to the site has been summarised in **Table 8.**

Table 8. Final Flood Risk Summary

Flood Risk Source	Mitigation Proposed	Final Risk Level
Tidal	Raising FFLs 600mm above the design flood level. Raising car park entrance in salt lake to 7.9mAOD.	Low
Fluvial	N/A	Low
Surface Water	N/A	Low
Groundwater	N/A	Low
Sewers	N/A	Low
Artificial Sources	N/A	Low

This report therefore demonstrates that, in respect to flood risk, the proposed development:

- Is suitable in the proposed location;
- Will be adequately flood resistant and resilient;
- Will not place additional persons at risk of flooding;
- Will not increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage or impedance of flood flows; and
- Will put in place measures to ensure surface water is appropriately managed.

This report concludes that in flood risk context; the proposals are safe and appropriate and do not increase flood risk.