

REPORT

Holyhead Waterfront

TAN15 Flood Consequence Assessment

Client: Conygar Investment Limited PLC

Reference: PB8908-RHD-ZZ-XX-RP-Z-0073

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Abbreviations

| | |
|---------------------|--|
| AOD | above Ordnance Datum (Newlyn) |
| CCTV | Closed-circuit Television |
| CD | Chart Datum |
| CFBD | Coastal Flood Boundary Data |
| Conygar | Conygar Investment Company PLC |
| EA | Environment Agency |
| FCA | Flood Consequence Assessment |
| Holyhead Waterfront | Holyhead Waterfront Regeneration Scheme |
| IoACC | Isle of Anglesey County Council |
| LiDAR | Light Detection and Ranging |
| NRW | Natural Resources Wales |
| RHDHV | Royal HaskoningDHV |
| SMP | Shoreline Management Plan |
| SuDS | Sustainable Drainage Systems |
| TAN15 | Technical Advice Note (TAN) 15: Development and Flood Risk |
| UKCP09 | UK Climate Projections, June 2009 (superseded) |
| UKCP18 | UK Climate Projections, September 2018 |

1 Introduction

Conygar Investment Company PLC (Conygar) is applying to Isle of Anglesey County Council (IoACC) for planning consent for a Waterfront Development at Holyhead

The Holyhead Waterfront site comprises approximately 34 hectares of partially developed seafront land, which stretches approximately 1.4km along Newry Beach towards the Grade II Listed Holyhead Breakwater as shown in Figure 1-1.

The development is split into two discrete areas, one to the West (Porth y Felin) and one to the East of the Trinity Marine development and boatyard (Newry Beach).



Figure 1-1: Proposed current masterplan indicating key character areas of the Holyhead Waterfront Development (Conygar, Virtual Consultation, January 2021)

The proposed Holyhead Waterfront development consists of a mixed-use regeneration scheme, which includes:

- A 250 berth capacity marina including associated breakwater(s);
- Six apartment buildings in the Newry Beach area providing 108 new homes in a mix of apartment types and associated reclamation areas;
- Small scale retail units to provide local community facilities and services;
- Creation of a terrace inlet and new public amphitheatre;

- New marina office building incorporating welfare, shower and laundry facilities and bar/restaurant;
- Two new commercial units earmarked for marine light industry;
- Additional commercial units for a mix of potential uses;
- Remodelling and extension of the existing Holyhead Sailing Club;
- A new covered arcade for community market and/or craft fairs and performance space;
- A newly reclaimed parcel of land at Porth y Felin providing 136 new homes in a mix of apartments, terraced housing, dwellings and villas;
- Sympathetically remodel the listed heritage assets at Soldiers Point and convert them back into residential use;
- Creation of a public coastal promenade and cycle route that connects Newry Beach to Soldiers Point and Breakwater Country Park beyond.

1.1 Our Role

Royal HaskoningDHV (RHDHV) has been appointed by Conygar to support them with the technical engineering and environmental aspects of the proposed development. As part of this appointment Conygar commissioned RHDHV to undertake a Flood Consequence Assessment in accordance with Welsh Government TAN15 guidance.

1.2 History and Purpose of this Document

In February 2014 Isle of Anglesey County Council (IoACC) granted Conygar Stena Line Ltd now Conygar Investment Company PLC (Conygar) outline planning permission for a significant waterfront development in Holyhead.

The 2014 consented scheme was supported by a Flood Consequence Assessment (FCA) produced in 2010 by Black and Veatch.

Since the 2014 consenting process, the scheme has undergone considerable design refinement, primary amongst which is a reduction in the size of the development. In July 2020 the 2010 FCA was rewritten by Ambiental Environmental Assessment (a subsidiary of RHDHV) based on the original scheme but adjusted to suit contemporary guidance and legislation (including Sustainable Drainage (SuDS) Statutory Guidance) and updates to climate change forecasts and associated changes to sea level rise predictions etc..

This new FCA report has now been re written to reflect the details of the updated scheme on the basis of the current guidance and legislation

Whilst this FCA is written to support an new planning application, it is noted that the previous Outline Planning Decision Notice (19C1046A/EIA/ECON) dated 14 February 2014, identified a number of Planning Conditions, some of which were relevant for the consideration as part of the management of flood risk at the site (a copy of which is Provided in Appendix I). The information requested in these conditions has been considered when preparing this FCA.

The specific Planning Conditions relevant to the management of flood risk were:

- 21. Prior to commencement of the Preliminary, Enabling, Access and Infrastructure Works, details of the proposed finished floor levels and site levels of the proposed development shall be submitted to and agreed in writing with the Local Planning Authority. The development platform level shall be set above the critical coastal flood event (1 in 200 return period 100 years of climate change).
- 22. Prior to commencement of the Preliminary, Enabling, Access and Infrastructure Works details of the new sea walls fronting and adjoining the site shall be submitted to and agreed in writing with the Local Planning Authority. Details to be submitted shall include the extent of the sea walls; their location; materials, structure and height.
- 23. Parapet wall details, construction type and crest height shall be submitted to and approved in writing by the Local Planning Authority and shall be carried out in accordance with the details provided.
- 24. As part of any reserved matters submission details of water exclusion measures to prevent the flooding of any below ground accommodation shall be submitted to and approved in writing by the Local Planning Authority and shall be carried out in accordance with the details provided.
- 25. Prior to commencement of the Preliminary, Enabling, Access and Infrastructure Works details of the proposed surface water drainage system shall be submitted to and agreed in writing with the Local Planning Authority. These details shall include flap and valve specifications and their locations; the existing and proposed outfall system and their locations and appropriate maintenance and management schemes for the drainage systems.
- 27. Foul water and surface water discharges to be drained separately from the site.
- 28. No surface water shall be allowed to connect, either directly or indirectly to the public sewerage system unless otherwise approved in writing by the Local Planning Authority.
- 29. Land drainage run-of shall not be permitted to discharge, either directly or indirectly, to the public sewerage system.
- 30. Any increase in surface water flows shall be attenuated to the satisfaction of the Local Planning Authority.
- 31. Prior to commencement of the Preliminary, Enabling, Access and Infrastructure Works a scheme for the comprehensive and integrated drainage of the site showing how foul water, surface water and land drainage will be dealt with shall be prepared and approved in writing by the Local Planning Authority and shall be carried out in accordance with the details provided.

¹<https://gweddill.gov.wales/topics/planning/policy/policyclarificationletters/2016/cl-03-16-climate-change-allowances-for-planning-purposes/?lang=en>

¹<https://www.anglesey.gov.uk/documents/Docs-en/Highways/Flooding/Flood-Risk-in-Anglesey-be-prepared.pdf>

¹<https://www.anglesey.gov.uk/documents/Docs-en/Planning/Planning-policy/Local/Supporting/Topic-Paper-8-Strategic-Flood-Consequences-Assessment-Level-1.pdf>

¹<https://gweddill.gov.wales/topics/environmentcountryside/epq/flooding/drainage/?lang=en>

2 Background Data

2.1 Topography

According to 2m LiDAR data existing ground levels across the site generally fall from the south to Holyhead Bay in the north. With levels varying from approximately 20mAOD to 3mAOD.



Figure 2-1: LiDAR Data (ground surface model) indicative site area shown by red outline

2.2 Geology

According to the previous FCA's:

“The site is underlain by Late Pre-Cambrian highly deformed chlorite mica schist bedrock (the New Harbour Group) which is within 3m of ground surface across most of the site and within 1m across a significant proportion of that. Overlying the bedrock is some Glacial Till in the area around Soldiers Point and Rocky Gaerwen Soils across the remainder of the area. The rocks and soils underlying the site are classified as a Non-Aquifer however there is evidence of some groundwater being present as small perched deposits at the surface of the underlying bedrock.

A geophysical survey of the harbour carried out by Shoreline Surveys shows that the bedrock is at or close to the seabed over much of the proposed marina site, overlain by a maximum of 2m thickness of superficial deposits in the deepest water.”

The geophysical survey was undertaken in 2009 and the findings were verified by physical investigations 2020.

3 Development Advice Map Classification and Development Strategy

Under TAN15 (see Figure 3-1), flood risk should be considered when considering new developments, and should direct new developments away from those areas which are at high risk of flooding. Where development has to be considered in high risk areas (Zone C) only those developments which can be justified on the basis of the tests outlined in section 6 and section 7 can be located within such areas.

| Description of Zone | | Use within the precautionary framework |
|---|----|--|
| Considered to be at little or no risk of fluvial or tidal/coastal flooding. | A | Used to indicate that justification test is not applicable and no need to consider flood risk further. |
| Areas known to have been flooded in the past evidenced by sedimentary deposits. | B | Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further. |
| Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal) | C | Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences. |
| Areas of the floodplain which are developed and served by significant infrastructure, including flood defences. | C1 | Used to indicate that development can take place subject to application of justification test, including acceptability of consequences. |
| Areas of the floodplain without significant flood defence infrastructure. | C2 | Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered. |

Figure 3-1: Composition and use of Development Advice Map Zones (Figure 1 TAN15)

An excerpt from Welsh Government open WMS layer (Figure 4) has been used to overlay the Development Advice Map Zones onto aerial imagery (Figure 5). This indicates that parts of the site (at current ground levels) lie variously located in Zone C2 and others in Zone B, or Zone A.

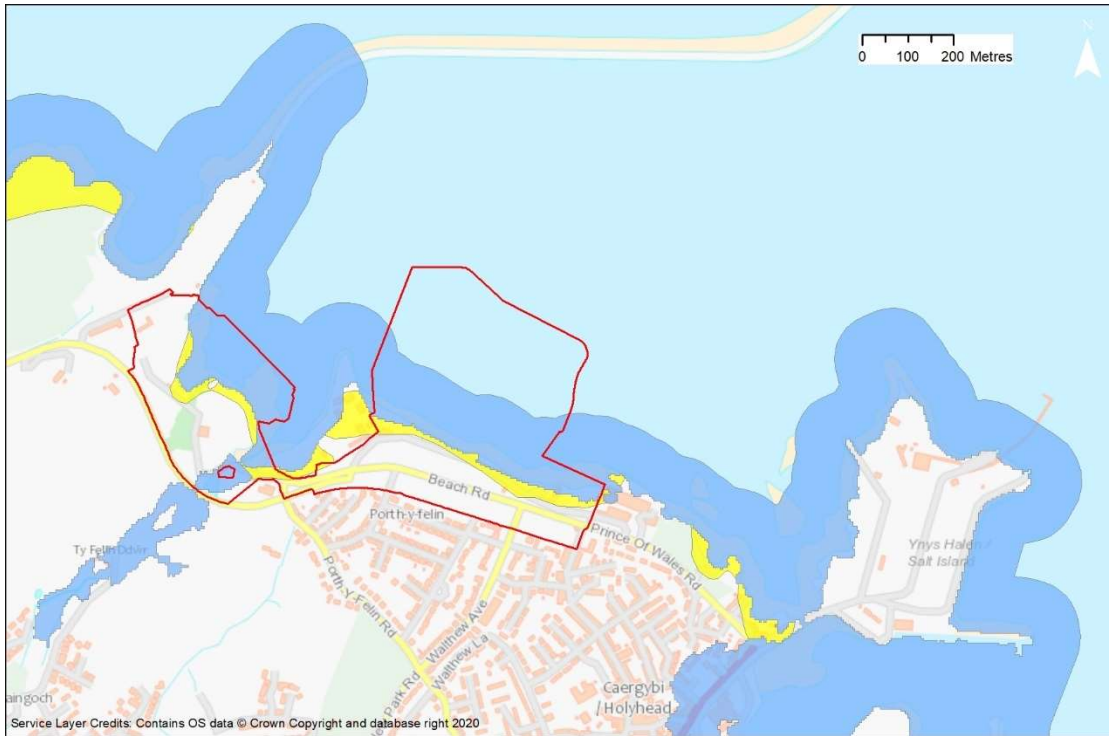


Figure 3-2: Development Advice Map Screenshot: Zone C2 = Blue, Zone B = Yellow, Zone A = Clear



Figure 3-3: TAN15 Development Advice Map (WMS Layer) overlaid onto Google Aerial Imagery. Zone C2 = Blue, Zone B = Yellow, Zone A = Clear

https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=1

3.1 Development Strategy

As part of the development proposals, a mitigation strategy to raise the ground level of the site is proposed, along with coastal reclamation works, to provide more developable area. The combined mitigation and coastal reclamation strategy will be to ensure that all developed areas are compliant with the conditions for Zone A, i.e. “considered to be at little or no risk of fluvial or tidal/coastal flooding”.

For clarity Figure 3-4 below, indicates the Development Advice Maps with the proposals overlaid.

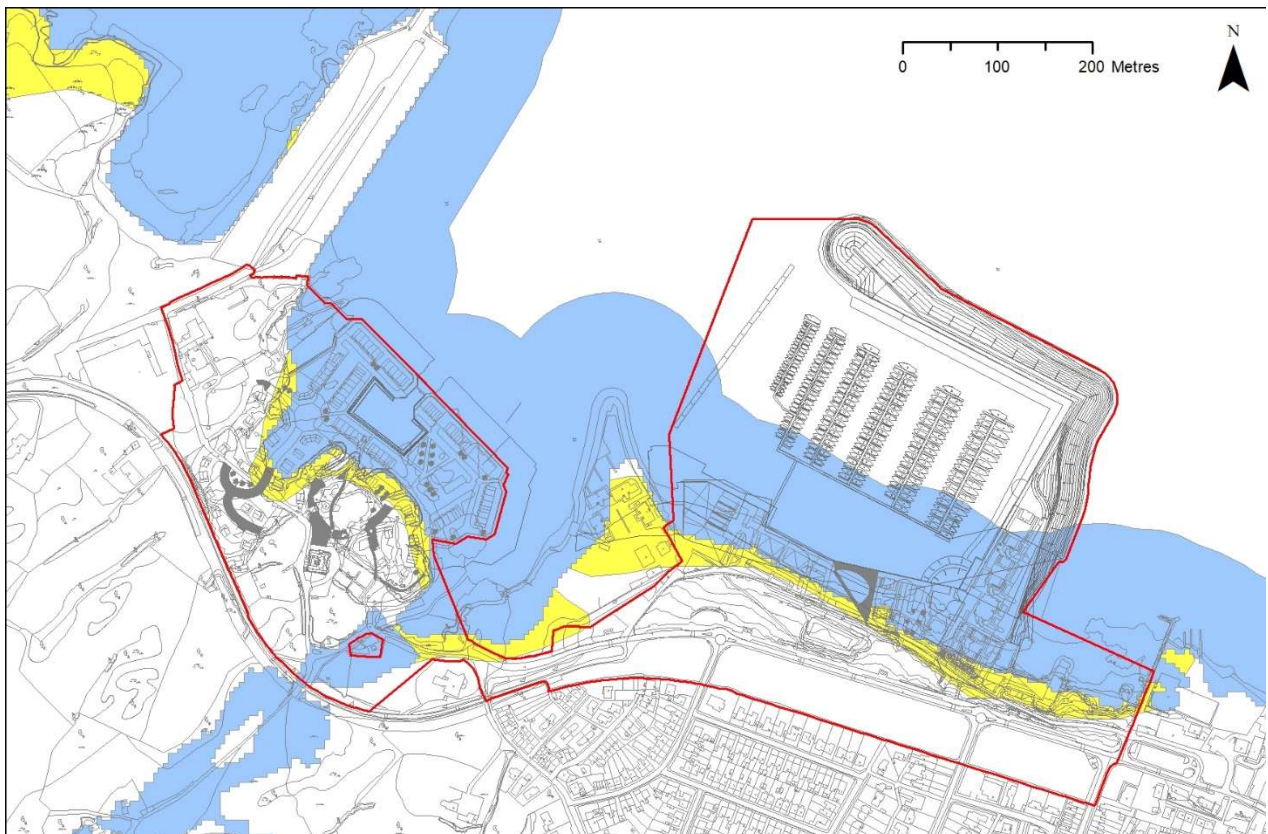


Figure 3-4: TAN15 Development Advice Map (WMS Layer) overlaid by development proposals. Zone C2 = Blue, Zone B = Yellow, Zone A = Clear

4 Climate Change Allowances

The Welsh Government in 2016, published updated climate change allowances for use in Planning Purposes. The advice is split between different regions (Figure 4-1), with the proposed development located in the ‘Western Wales’ River Basin District.

River Basin Districts

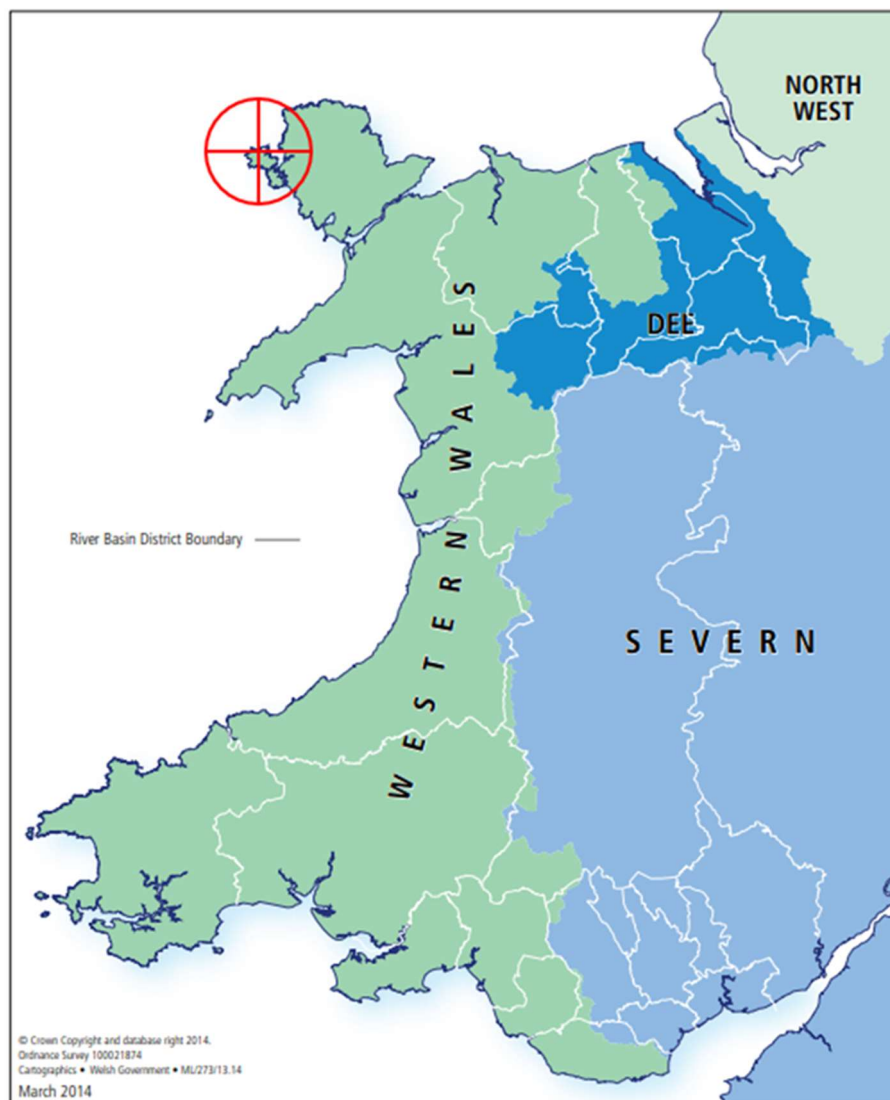


Figure 4-1: River Basin Districts

The climate change guidance indicates that for River Flows a 30% increase should be allowed for, based on the application of the Central Estimate (Change Factor). Furthermore, the guidance identifies that based on a 2008 reference year sea level, an allowance of 1152mm for residential up to 2120 (100 years) and 789.5mm for commercial up to 2095 (75 years) should be allowed for when considering the potential change in sea levels, as a result of climate change.

However, a recent publication to the general UK Climate Projections was published in September 2018 (UKCP18). Within UKCP18 sea level rise projection comes in two datasets, 21st century projections (from

2007 to 2100) and Extended (exploratory) projections (from 2007 – 2300). By applying the RCP8.5 model prediction, which is comparable to high emissions scenario from UKCP09, the predictions of sea level rise has used 21st century projections up to 2100 and then Extended projections from 2100 up to 2120. The results in a slight increase in the predicted estimate of sea level rise for this development of 1320mm over the next 100 years.

Given the recent UK guidance (UKCP18) indicates an increase in the climate change allowance required for sea level rise, this flood consequence assessment has used these updated predictions over the Welsh Government guidance of 2016.

The guidance does not provide any advice regarding the allowance on rainfall events, and therefore it is assumed that a 30% allowance in accordance with the original TAN15 allowances should be considered.

The impacts of climate change on the flood risk profile are discussed under the relevant sections below.

5 Site Flood Hazards

5.1 Causes of flooding

Generally, the most common forms of flooding are as follows:

- River flooding that occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment.
- Coastal flooding that results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen which can cause serious flooding.
- Surface water flooding which occurs when heavy rainfall overwhelms the drainage capacity of the local area. It is difficult to predict and pinpoint, much more so than river or coastal flooding.
- Sewer flooding that occurs when sewers are overwhelmed by heavy rainfall or when they become blocked. The likelihood of flooding depends on the capacity of the local sewerage system. Land and property can be flooded with water contaminated with raw sewage as a result. Rivers can also become polluted by sewer overflows.
- Groundwater flooding that occurs when water levels in the ground rise above surface levels. It is most likely to occur in areas underlain by permeable rocks, called aquifers. These can be extensive, regional aquifers, such as chalk or sandstone, or may be more local sand or river gravels in valley bottoms underlain by less permeable rocks.

5.2 Mechanisms of Flooding

The NRW Development Advice Map (Figure 3-2) indicates the site to be located within Zone C2 (areas without significant flood defences). Table 5-1 summarises the potential sources of flooding to the site.

The proposed development is not within an area that is considered to currently benefit from flood defences.

Table 5-1: Summary of flood sources

| Source | Description |
|---------------|---|
| Historic | No historic records identified. |
| Fluvial/Tidal | Flood Zone C2 |
| Surface | Discreet areas are at risk of surface water flooding attributable to offsite flows. |
| Groundwater | The risk of groundwater flooding is low. |
| Sewer | Low risk of sewer flooding. |

5.3 Records of Historical Flooding

The Natural Resources Wales Historic flood extent outline does not indicate any records of flooding having occurred at the existing land areas of the development site.

The Anglesey Strategic Flood Consequences Assessment indicates one historic flood event, however, this is not in close proximity to the site, and was recorded in 1907.

5.4 Fluvial/Tidal Flood Risk

As noted in 3.1 above, development strategy is to raise existing and reclaimed development land to comply with TAN15 Zone A classification. TAN15 Appendix 1 indicates that for Tidal Flooding, the zero-flooding threshold should be 0.5% annual exceedance, or a 1 in 200 year event. The development proposals have been developed so that this condition will be met at the end of the adopted 100 year design life, including current predictions for sea level rise.

As such, the standard of protection (SoP) provided at the start of the life of the development will thus be higher than 1 in 200 years, with the SoP eroding over time to 1 in 200 years at the end of the 100 year design life, taken to be in 2120.

5.4.1 Approach to “Tidal” Flood Defence

Flooding from the sea can arise from a combination of tidal levels (still water level) and wave “overtopping”.

By inspection, at extreme high tides, flooding will occur with either no or relatively small wave activity, whilst if larger waves occur at lower tide level, flooding may still occur. The most onerous conditions would occur when large waves combine with high tide levels.

The adopted strategy for resisting flooding from the sea will be to provide a minimum development platform level high enough to resist the extreme 1 in 200 year (2120) sea level, allied to a combination of crest walls and breakwater water protection to provide defence against wave over-topping.

5.4.2 Design Still Water Level (Tidal)

The Environment Agency’s (EA) Coastal Flood Boundary Data study (CFBD) for the UK Mainland and Islands (Environment Agency, 2019) indicates that the nearest present day 200 year return period tidal flood level for the area with a confidence level of 95% would be between 3.91 and 3.94m AOD, see Figure 10.

Based on the climate change allowances identified by the recent updated UK Climate Change guidance (UKCP18), for 100 years of sea level rise, an allowance of 1.32m needs to be included, which would give a 200 year return period tidal flood level of 5.26m AOD in 2120.



Figure 5-1: DEFRA Coastal Sea Level Predictions (present day) 200 year return period event

As part of the design review of shoreline flood risk for the site, RHDHV, has undertaken a detailed review of the tidal flood levels and flood defences for the area. The aim of the detailed review is to determine a safe development level, when accounting for the latest climate change projections over the lifetime of the development. This study has included consideration of wave overtopping, to inform a suitable development level. The design 'still water level' for the 200 year return period tidal flood level in 2120, including 150mm freeboard, has been calculated as 5.26m AOD

5.4.3 Minimum Development Level

TAN15 (A1.14) recommends a precautionary approach to determining finished floor levels and that floor levels of all buildings should be at least 150mm higher than the surrounding finished ground levels.

Therefore, the lowest ground floor level should be 5.40m AOD.

Furthermore, TAN 15 advises that all sleeping accommodation should be at least 600mm above the design flood level, i.e. should be set to a minimum of 6.00m AOD.

Finished ground levels should be designed to fall towards Holyhead bay, so that any exceedance drainage flows from the development are directed towards the tidal edge of the site, to prevent accumulation within the site.

5.4.4 Defence Against Wave Over Topping

As previously noted, the site will be elevated to resist tidal levels, however inundation from wave over will need to be resisted by other means, primarily by a combination of new and existing breakwaters and crest walls built along the new frontages.

The sufficiency of the existing and proposed breakwater defences has been established by a series of waves models generated by RHDHV to determine the design and extreme wave heights in the various parts of the development site.

Due to the geometry of the breakwaters, different wave conditions will exist at the Porth y Felin and the Newry Beach / East Breakwater sites and hence different defence solutions will be provided in each area.

5.4.5 Role of Holyhead Breakwater

The existing Holyhead Breakwater provides partial shelter to the whole of Holyhead Harbour, primarily resisting waves from the Irish Sea. Holyhead Breakwater is essential to the future commercial viability of the port, and its continued presence will provide defence from wave inundation for the Holyhead Development.

The validity of placing reliance in the continued presence of Holyhead Breakwater is supported by the consideration for the provision of flood defence at the site and adjacent areas in the recently updated Shoreline Management Plans (SMP). SMP set out the government's preferred level of intervention regarding flood defences around the UK coastline.

The long-term SMP for the site, is indicated in Figure 5-2, which shows that at present the policy for the area is 'Hold the Line' (green), which means the level of flood protection over the next 100 years would be maintained to the current level of protection.

For the purposes of providing defence to the development site, therefore, the continued protection provided by Holyhead Breakwater has been assumed.

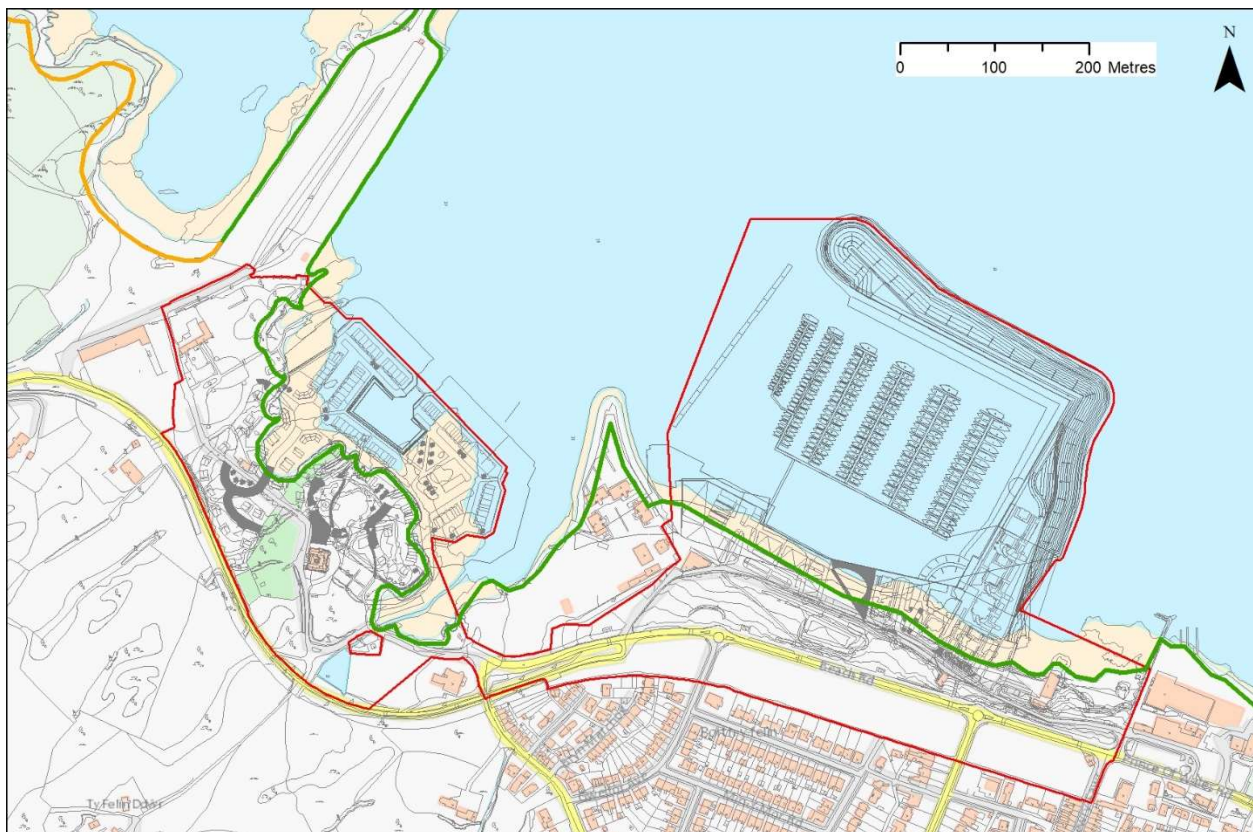


Figure 5-2: Current Shoreline Management Plan for the next 100 years

5.4.6 Additional Wave Protection

Holyhead Breakwater provides shelter from waves arriving from the Irish Sea. However, particularly as the angle of approach moves round to the North ($360^{\circ}/0^{\circ}$) some residual wave energy does enter Holyhead Harbour and approaches the development site from the North East. Furthermore, locally generated waves also approach the site, primarily from the North East to East quarters. Whilst these waves are smaller and less powerful than the waves that are resisted by the Holyhead Breakwater, their effects can be significant.

In order to provide a sufficiently sheltered water space for the proposed Holyhead Marina (to be constructed as part of the Holyhead Development) a new breakwater is to be constructed as shown on the scheme development drawings - the "East Breakwater".

The new breakwater has been designed in conjunction with a wave modelling programme to inform its position and geometry, with a design life of 100 years and with the same allowances for climate change as the remainder of the development.

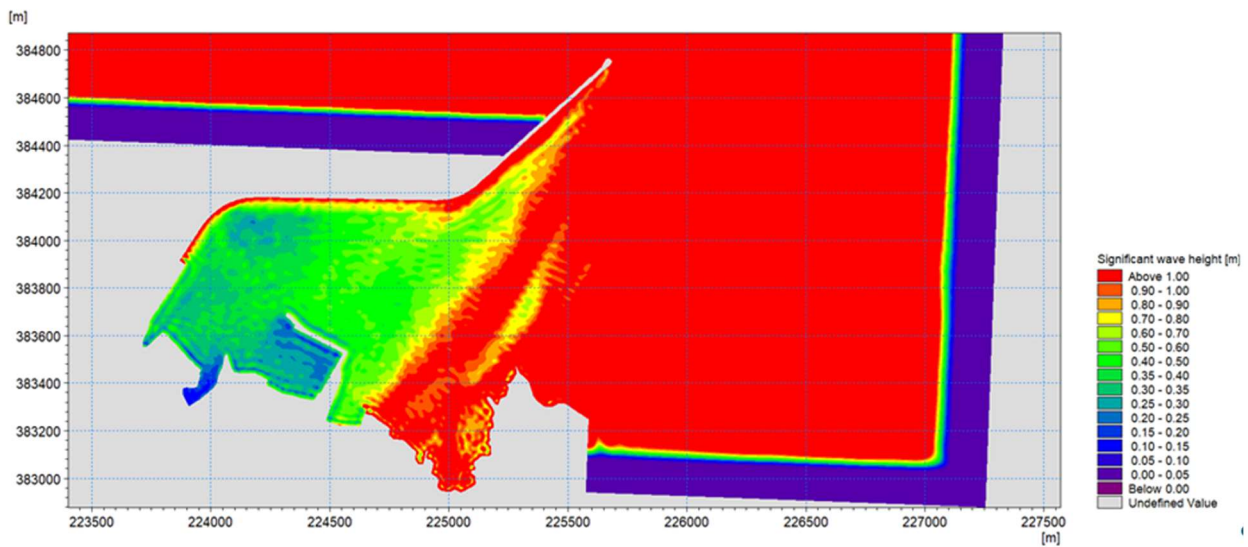


Figure 5-3 - Wave model results for 1 in 1 year waves propagating from 360/0 degrees (North)

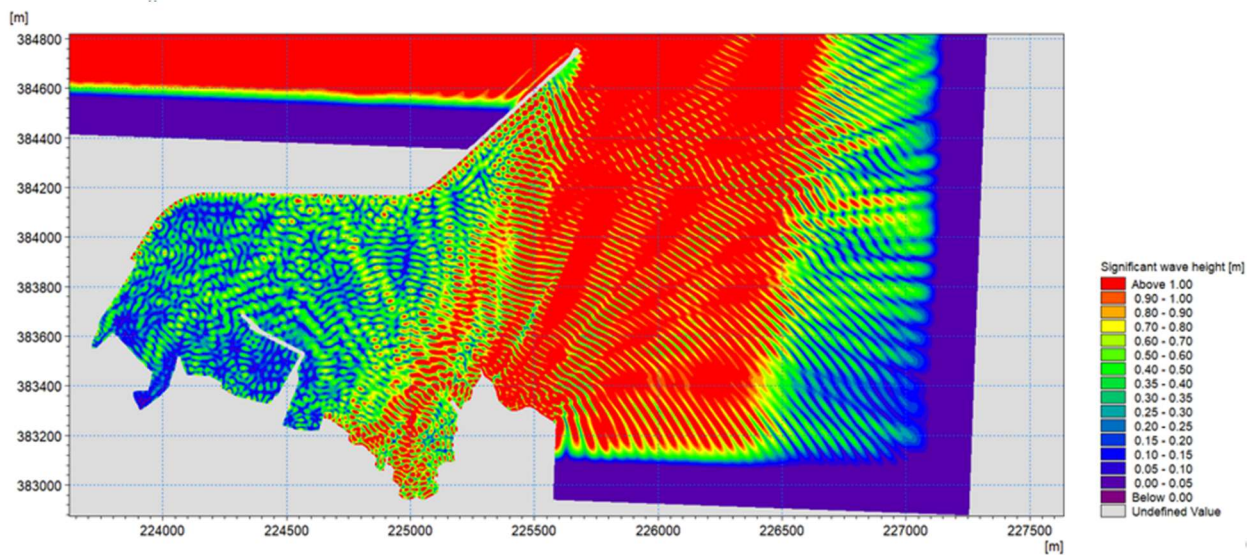


Figure 5-4 - Wave model results for 1 in 1 year locally generated waves propagating from 60 degrees

From the wave modelling, the new Eastern Breakwater will provide good shelter to the Porth y Felin and Newry Beach frontages from the locally generated waves, as well as providing good shelter from the larger waves penetrating to the Newry Beach frontage from the North.

For Porth y Felin, however, the frontage will not be so protected from waves from the North.

The proposed development on the Eastern Breakwater will be protected from the northern waves, but will not be protected from the locally generated waves

| Part of Development Site | Wave Protection | |
|-----------------------------|---------------------|--|
| Porth y Felin | Holyhead Breakwater | New East Breakwater plus Frontage Crest Wall |
| Newry Beach | Holyhead Breakwater | New East Breakwater |
| East Breakwater Development | Holyhead Breakwater | Frontage Crest Wall |

Table 5-2 - Wave Protection Measures within the Development

5.4.7 Standard of Wave Overtopping Defence

The design of the water's edges including crest walls will be based designed for a 200 year combined still water level and wave high return period event. The acceptable overtopping limit of 10 l/s per m has been set based on the assumption that all properties and services will be set back at least 10m from the waterside edge which will thereby reduce any wave action flooding to acceptable levels at the line of properties and services.

5.4.8 Summary of Tidal Flooding Risk

On the basis that the development plateau will be raised above the tidal flood risk level and with additional defence provided by the existing and new breakwaters plus crest walls where appropriate, the risk of tidal (and wave) flooding is assessed to be VERY LOW.

5.5 Surface Water (Pluvial)

The Natural Resources Wales (NRW) Risk from Surface Water Flood Mapping, see Figure 5-5, shows the site to contain discreet areas with high to low risk of surface water flooding, especially within the areas with existing buildings and hard standing. There are a number of surface water flow paths that drain into the site from higher ground to the south. These flow routes will need to be accommodated as part of the overall drainage strategy for the scheme.

Post development these overland flow routes would need to be collected by the onsite drainage system, which will be sized to accommodate the overland flow run-off from adjacent sites, and enable a direct discharge into Holyhead Bay..

As part of the review of surface water flood risk at the site a direct rainfall model for the baseline situation has been developed, which generally aligns with the findings of the Natural Resources Wales surface water flood models. The site-specific model has considered the design rainfall run-off as calculated by the Flood Estimation Handbook methodology, and this has been applied to the ground terrain determined by LiDAR data. The catchment area has been defined based on the total upstream catchment area contributing to surface water run-off towards the site. The surface water modelling shows that to accurately represent the flow paths to the site, a topographic survey of the coastal road (which currently shows flows being intercepted) would be required to accurately represent the existing culverts and crest height of the road.

A strategy for the management of surface water flows is provided in Section 6.

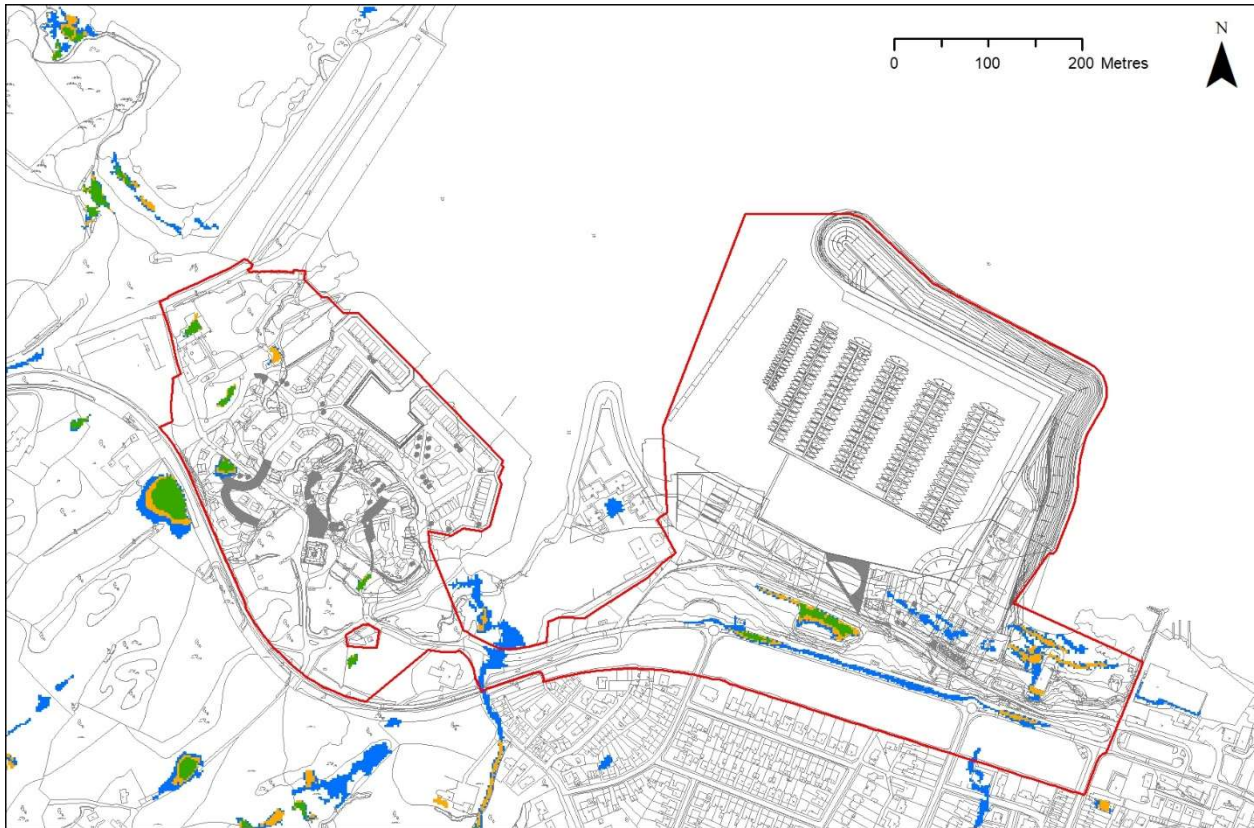


Figure 5-5: Surface Water Flood Risk Map. (Source: Natural Resources Wales)

The results of the site specific flood modelling indicate that the western portion of the development lies on two surface water flow routes, which although the predicted peak water depths are fairly shallow (less than 300mm), the modelling indicates that significant ponding would occur upstream of the current coastal road. However, the model at present does not have sufficient data to accurately simulate the flow conditions through the structure. Furthermore, the results do not account for the proposed land raising that is to occur, or the proposed surface water drainage infrastructure, which will need to be sized to accommodate this overland flow, and not result in surface water displacement.

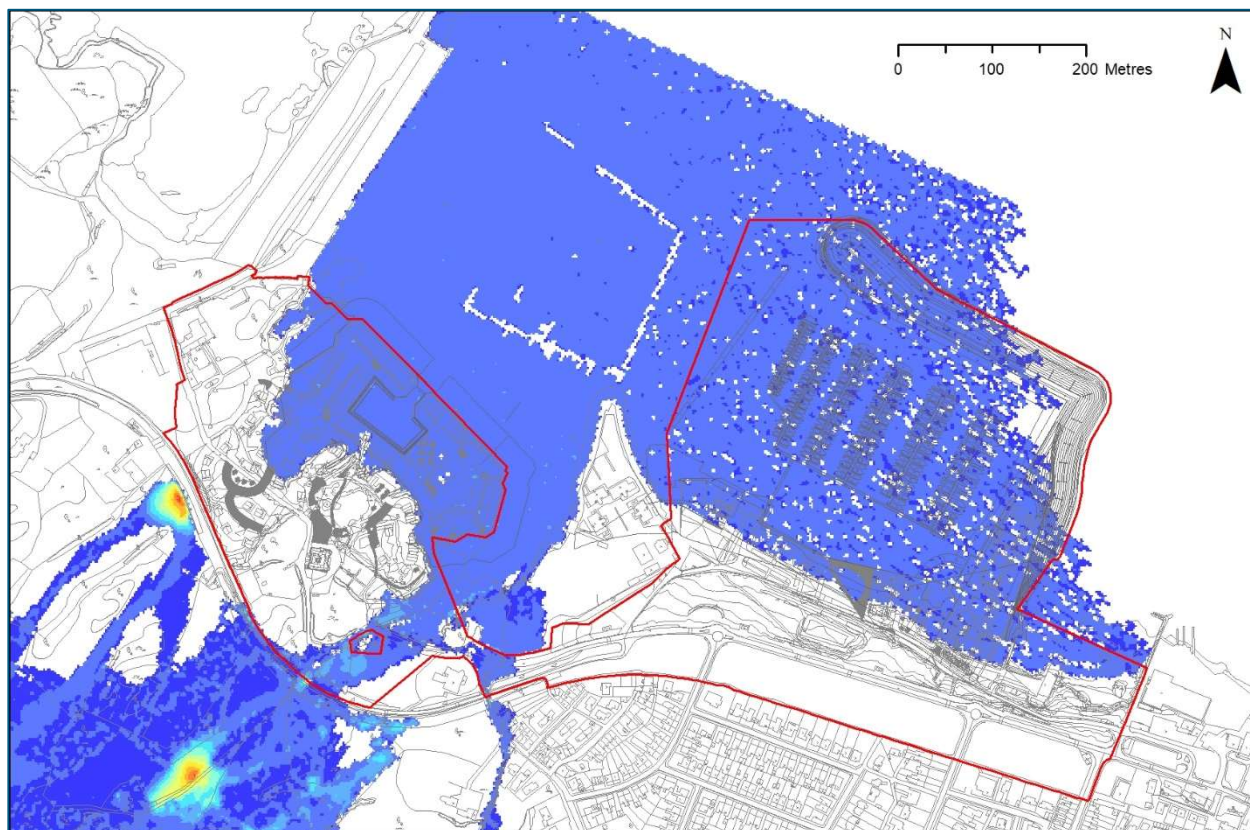


Figure 5-6: Site specific surface water flow modelling, using TUFLOW, FEH Design Rainfall and 4m resolution grid.

Following implementation of a surface water drainage strategy for the site, the risk of surface water flooding will be LOW. Therefore, the surface water drainage strategy will provide effective mitigation.

5.6 Groundwater

Groundwater flooding is the emergence of groundwater at the ground surface or into subsurface voids or structures, arising as a result of:

- abnormally high groundwater heads or flows;
- the introduction of an obstruction to groundwater flow; or
- the rebound of previously depressed groundwater levels.

Groundwater flooding most commonly occurs in unconfined aquifers; either major aquifers from which considerable amounts of water can be discharged or in shallow permeable sediments. Flooding locations are typically near areas of natural groundwater discharge such as river valleys and spring lines.

In order to provide adequate flood defence to the site from the risk of tidal flooding it is proposed to raise ground levels across the site, this would also provide adequate mitigation for the risk of groundwater flooding.

Raising ground levels at the site will reduce the risk of groundwater flooding to a LOW level, and no further mitigation measures are anticipated.

5.7 Sewer

Sewer flooding is usually associated with a failure (blockage or collapse) or a lack of sewer capacity to convey the surface water flood event. The long-term flood risk from surface water map provides an indication of the likely direction of flows resultant from sewer flooding. A sewer failure could occur at any point on the network and is considered to be a residual risk.

A CCTV sewer survey should be undertaken to assess the condition and connectivity of the existing sewers within the site. The findings of this survey should be used to inform the detailed drainage design for the area.

Where new sewer connections are proposed, liaison with the appropriate water authorities will be required, with regards to a sewer connection. For surface water discharges into Holyhead Bay appropriate permits and licences will need to be obtained from Natural Resources Wales. For new Sewer Connections consent will be needed from Welsh Water.

To minimise the potential for sewer flooding foul and surface water sewer systems should be kept separate, and non-return valves or similar protection measures should be installed, to prevent the public sewers from surcharging into the lateral drains serving the new properties. Where possible the finished floor levels of new buildings should be set at least 150mm above the surrounding ground level, and landscaping and ground levels should be designed to fall away from buildings, especially doorways and other points of access.

The risk of sewer flooding is therefore assessed to be VERY LOW, and apart from the good practice measures outlined above, no further mitigation measures are necessary for the Proposed Development.

6 Surface Water Management Strategy

A central component of sustainable surface water management is to demonstrate how the increases in impermeable surfaces, and the associated increases in surface water run-off will be mitigated. Fundamentally it needs to demonstrate that:

- The total rate of surface water discharged from the site will not be greater post-development than it was pre-development; and,
- The water quality discharged from the site, will not be polluted by particles and other material mobilised from the ground surfaces as a result of rainfall events.

The above objectives are achieved through the provision of surface water storage (attenuation) and the provision of Sustainable Drainage Systems (SuDS). Surface water run-off generated by development sites, where impermeable surface areas are increased, have the potential to exacerbate flood risk to others, by increasing the peak rate of surface water discharged from the Site.

A drainage strategy drawing is provided in Appendix II, which indicates a significant proportion of the development area could be set aside for permeable paving, due to the significant provision of ground level car parking within the scheme.

However, it is noted that the drainage strategy is predicated on allowing for run-off from the site to the sea and as such the requirement to limit run of rates is obviated as the flow rates will not impact on existing watercourses or drainage systems.

¹<https://gweddill.gov.wales/topics/environmentcountryside/epq/flooding/drainage/?lang=en>

6.1 S1. Surface water runoff destination

| Priority | Commentary | Implemented? |
|---|---|--------------|
| Priority Level 1: Surface water runoff is collected for use; | Rainwater harvesting (either complex or simple water butts) will be considered during the detailed design. | Yes |
| Priority Level 2: Surface water runoff is infiltrated to ground; | Proposals are to raise the site through imported fill material, it is not considered appropriate to discharge via infiltration through fill material. | No |
| Priority Level 3: Surface water runoff is discharged to a surface water body; | It is proposed to discharge all surface water from the development into Holyhead Bay. | Yes |
| Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system; | Unlikely to be required, due to proposed tidal outfalls. | No |
| Priority Level 5: Surface water runoff is discharged to a combined sewer. | Unlikely to be required, due to proposed tidal outfalls. | No |

6.2 S2. Surface water runoff hydraulic control

G2.1 This Standard applies to discharges to surface water bodies, surface water sewers or combined sewerage systems. However where the surface water body is unaffected by either the discharge rate or volume of runoff (e.g. an estuary, the sea or a water body identified in the Local Flood Risk Management Strategy (LFRMS) as not needing hydraulic control of runoff to it), the hydraulic management control requirements are limited to the drainage service provisions for the site and adjacent areas that could be affected by the performance of the drainage system.

As it is proposed to discharge the surface water to the tidal Holyhead Bay specific surface water runoff hydraulic controls are not required. The outfall structures will be equipped with tidal flaps and non-return valves to limit the potential for saline intrusion into the surface water drainage system.

The final arrangement of the surface water drainage system will be influenced by the structural detailing of foundations, sea defence walls, and other below ground construction activities. The detailed design may consider the construction of an array of surface water outfalls at each sea-wall outfall to reduce instances of freshwater plumes, and erosion risks within the marine environment.

6.3 S3. Water Quality

Adequate treatment must be delivered to the water runoff to remove pollutants through SuDS devices, which are able to provide pollution mitigation. Pollution Hazards and the SuDS Mitigation have been indexed in the CIRIA 753 'The SuDS Manual'.

The suitability of SuDS components has been assessed (based on Table 3 below) to determine which methods are appropriate to be used within the proposed development.

| SuDS Component | Description | Constraints and Opportunities | Suitability |
|----------------------|---|---|-------------|
| Infiltrating SuDS | Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils | Made ground usually precludes the use of infiltration methods of drainage. | X |
| Permeable Pavement | Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration | Permeable paving should be provided within suitable hardstanding areas. A clear zone for the provision of utility services should be allowed for outside of the permeable paving. Furthermore, infiltrating paving should be located at least 1.5 m away from proposed and existing building. | ✓ |
| Green Roofs | Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes | The volume of surface water attenuation achieved by green roofs, is limited, however, green roofs should be encouraged where practicable. | - |
| Rainwater Harvesting | Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected from roofs or other impermeable area, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties | As the volume within a Rain Water Harvesting system does not contribute to the overall attenuation, these systems have not been considered further here. However, opportunities during detailed design should be considered, this could be through the provision of water butts. | - |
| Swales | Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a | The use of made ground across the site, and there being no requirement to provide surface water attenuation at the site, limits the potential for large open landscaped attenuation features. | |

| | | | |
|------------------------------|---|---|---|
| | means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design | <p>Within the highway area, the use of rain-gardens to provide effective surface water drainage should be encouraged, subject to safety constraints from the Highway Authority</p> <p>Rain-planters on down-pipes can act as mini-bioretenion areas, which can effectively treat the run-off from the roof areas.</p> | |
| Rills and Channels | Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance, they also provide effectiveness in pre-treatment removal of silts | | X |
| Bioretention Systems | Bioretention systems can reduce runoff rates and volumes and treat pollution through the use of engineer soils and vegetation. They are particularly effective in delivering interception, but can also be an attractive landscape feature whilst providing habitat and biodiversity | | - |
| Retention Ponds and Wetlands | Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events | | X |
| Detention Basins | Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events and can be used as a recreational or other amenity facility. They generally appropriate to manage high volumes of surface water from larger sites such as a neighbourhoods | | X |
| Geocellular Systems | Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the | | ✓ |

| | | | |
|---------------------------------|---|---|---|
| | specific characteristics and requirements of any site | | |
| Proprietary Treatment Systems | Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS | If necessary, these could be provided to complement the other SuDS solutions. | ✓ |
| Filter Drains and Filter Strips | Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration | These will need to be considered as part of the evolving landscaping strategy | ✓ |

The proposed development is formed of multiple development types, and these are considered individually below:

- Building Roofs. All surface water run-off from buildings should be directed to a rainwater harvesting system for non-potable uses. Either a complex system, consisting of a collection tank, a pump and a distribution network, or a simple water butt shall be used. Any rainwater downpipes that do not discharge into a rainwater harvesting system should pass through a rain-planter (mini bio-retention device).
- Bus shelter or similar roofs/canopies. Any bus shelters / smoking shelters / bin stores should be provided with green roofs, these should be planted with suitable species to enable them to become 'Bee Stops'.
- Car Parking. All ground level car parking should be surface with at least 400mm of permeable paving subbase, to provide sufficient pollution control.
- Proposed Roads. It would be preferable to surface all proposed roads with Permeable Paving. However, if the Highway Authority are unwilling to permit permeable paving on the roads, then 'smart gullies' should be provided on all highway gullies.

6.4 S4. Amenity & S5. Biodiversity

The proposed development will provide wider amenity benefits by providing better facilities and access to the improved waterfront. Biodiversity could be improved by the provision of green roofs, and rain-planters.

Details of the landscaping arrangements on site, will, where practicable, include for the provision of rain-gardens.

6.5 S6. Design of drainage for construction, operation and maintenance

A long-term maintenance regime should be agreed with the site owners before adoption. In addition to a long-term maintenance regime, it is recommended that all drainage elements implemented on site should be inspected following the first rainfall event post-construction and monthly for the first quarter following construction.

Final ownership details for the surface water infrastructure onsite are yet to be confirmed. In the event that the features are to remain un-adopted, then a management company with suitable legal guarantees, would need to be established / appointed. A detailed site maintenance and management plan for the surface water drainage assets will need to be developed during detailed design.

| Item | Visual Inspection | Cleanse / De-sludge | CCTV Survey | Comments |
|---------------------------------------|--|--|-------------|---|
| Pipework, chambers etc. | 5 years | 10 years | 10 years | Cleansing to be carried as necessary. |
| Gullies/Channels | 1 year | 1 year | N/A | |
| Catchpits / Rain Planters | 1 year | As required | N/A | |
| Permeable Block Paving | Yearly | 'Swept' clean of debris every 2 years. | N/A | Lift blocks and remove sand bedding and replace and re-bed paving – refer to individual manufacturers' recommendations. |
| Outfall headwalls / non-return valves | Every month for the first 3 months and every 6 months thereafter | As necessary & 1 year | 10 years | Cleansing to be carried as necessary and at least every year. Refer to manufacturers' recommendations. |

¹ <https://www.naylor.co.uk/catalogue/smart-sponge/>

7 Foul Drainage Strategy

The proposed development will require the provision of new foul drainage infrastructure. Based on the consented scheme, foul drainage will drain via gravity to two foul pumping stations that will connect to the wider public sewer system, see Figure 7-1 and Figure 7-2

All new foul sewers should be installed as a separate system from the surface water sewer.

The new foul drainage system will need to be installed in accordance with the Sewer Authorities requirements and would be adopted and operated by them.

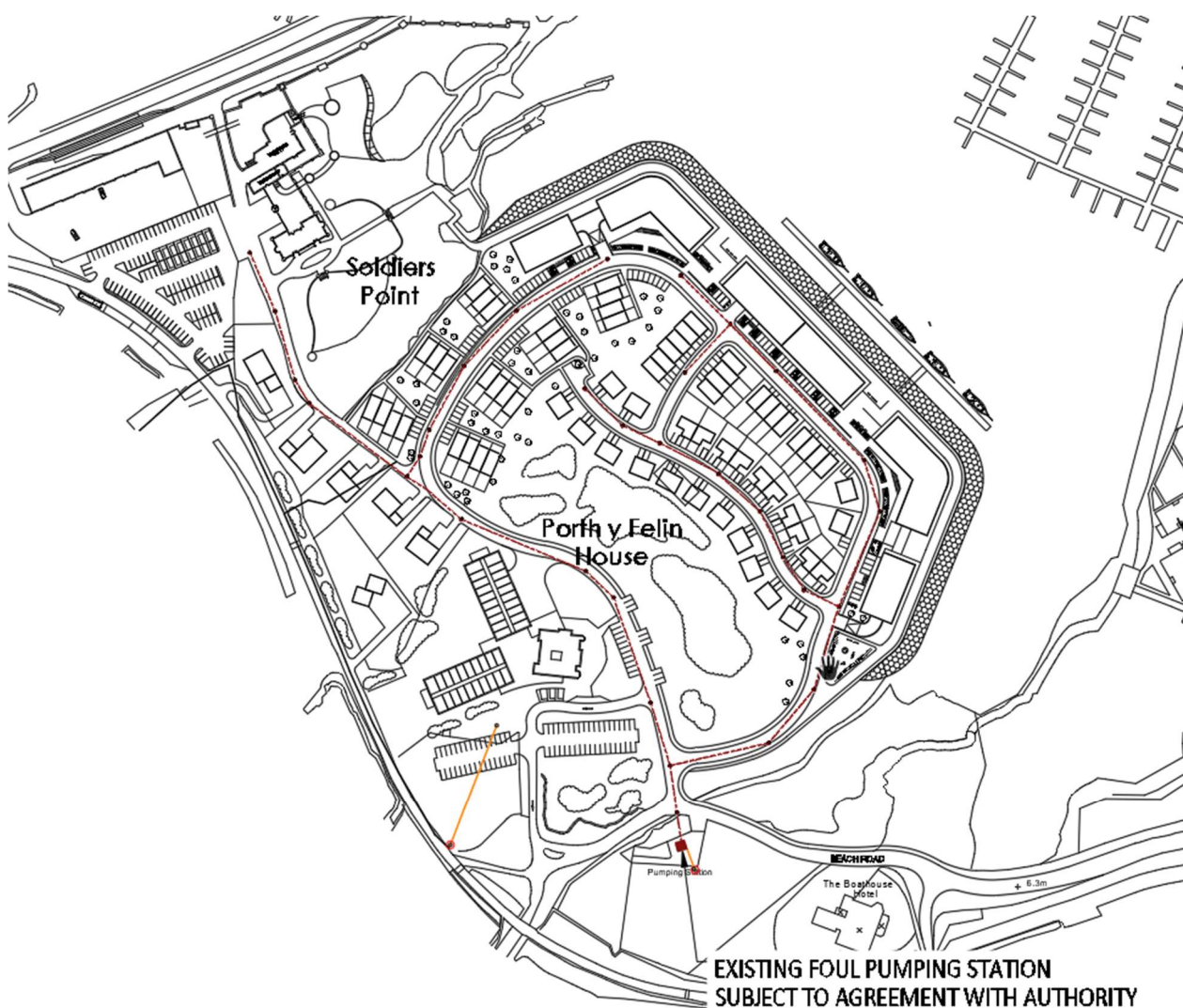


Figure 7-1: Foul Drainage Strategy Western Portion

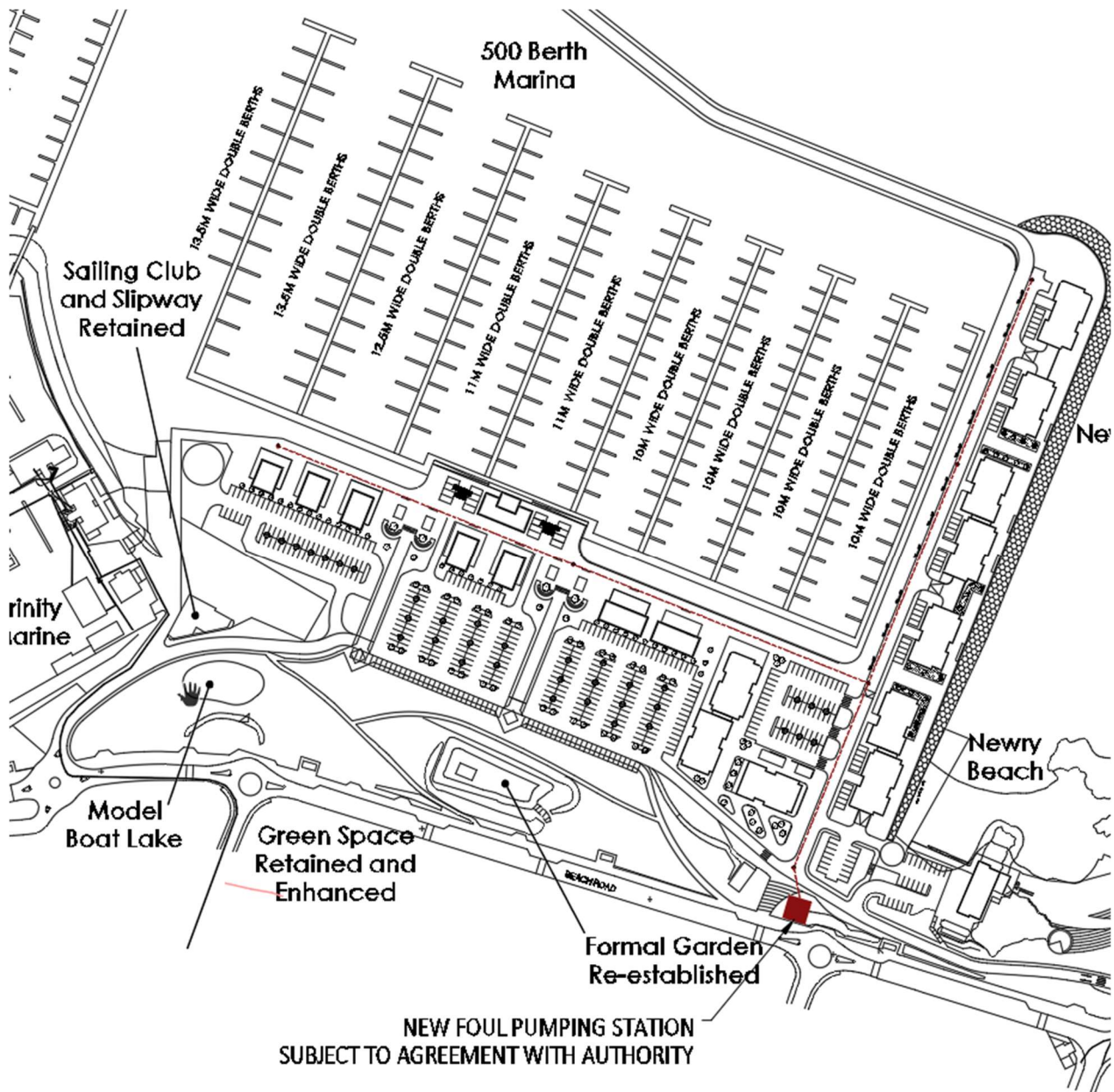


Figure 7-2: Foul Drainage Strategy Eastern Portion

8 Residual Risks

8.1 Identification of Residual Risks

Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir; or,

- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

8.2 Defence Breach

The proposed flood defence to protect the site from tidal flood risk will be through the construction of a raised development plateau, this defence is therefore unlikely to breach, and the consequence of a partial failure would be limited to the area around the failure, as all the proposed buildings would be above this level. Furthermore, all sleeping accommodation will be located an additional 600mm above the flood defence level for the site.

8.3 Reservoir Failure

The NRW Risk from Reservoir Map demonstrates that the site is outside flood extents in the event of reservoir flooding. Therefore, the site is not at risk of reservoir flooding, and no specific mitigation measures are required.

8.4 Drainage Exceedance

In the event of extreme rainfall events, flooding may occur within the site, the surface water runoff flows would be dictated by the local topography on site. Design of external ground levels need to be undertaken at detailed design stage to finalise overland conveyance routes. However, overland flow paths should be established to direct surface water run-off away from buildings and towards the tidal Holyhead Bay.

Should a rainfall event occur beyond the standards required under TAN15, then the capacity of the drainage infrastructure could be overwhelmed. The proposed buildings should be located at least 150 mm above the surrounding ground level.

8.5 Flood Risk Management Measures - Development within 3m of a Public Sewer

Based on the current information the proposed development is within 3m of a Public Sewer, and therefore easements or diversions are likely to be required. However, this should be confirmed with the Public Sewer Authority, and developed as part of the detailed drainage strategy.

8.6 Floodplain Compensation

Floodplain compensation is required when development proposals have the potential to displace floodwater, which could result in an increased risk of flooding to vulnerable types of land use.

Floodplain compensation is not normally required for tidal flooding, and therefore, for the proposal's floodplain compensation is not considered necessary.

8.7 Flood Risks

Based on the findings of this assessment it is recommended that the client should incorporate the following mitigation measures:

Construction:

- Ground floors to be solid (i.e. concrete floors) where possible, with waterproof membrane
- Wall cavities to be filled with closed-cell foam throughout

- Exterior ventilation outlets, utility points and air bricks to be fitted with removable waterproof covers
- External walls to be resistant to flooding to at least 900mm above external ground level
- Air brick protection
- Sleeping accommodation for the proposed development to be set to a minimum of 600mm above the flood design level of 5.40 m AOD
- Use of MDF carpentry (i.e. skirting, architrave, built-in storage) to be avoided at the ground floor level
- Incorporation of surface water drainage strategy measures

Electrical connection:

- Ground floor electrical main ring to be run at least 900mm above external ground level
- Electrical incomer and meter to be situated at least 900mm above external ground level.
- Bringing down electrical services from ceilings on the ground floor (where possible)

Gas / water supply:

- Boilers, control and water storage / immersion to be installed at least 900mm above external ground level, and where possible to be installed at first floor level or above
- Gas meter to be installed at least 900mm above external ground level
- All plumbing insulation to be of closed-cell design
- Non-return valves on sewers to prevent back-flow, to be installed separately on the foul and surface water systems to prevent “self-flooding”

8.8 Flood Warning Service

Although the site has been designed to have a development level above the predicted tidal flood level, should an exceedance event occur, residents and operators of the site should be aware of steps to be taken to maintain their safety.

Natural Resources Wales operates a flood warning service, through Floodline, which can be reached on the following:

- Telephone: 0345 988 1188
- Type talk: 0345 602 6340




This service provides frequently updated flood warnings and associated floodplain information.

During periods of bad weather, site users should monitor local weather reports and sign up for the UK Meteorological Office weather warnings. Warnings can be monitored through an Apple/Android app, Twitter or directly via emails. Further information can be found at <https://www.metoffice.gov.uk/>.

Predicted tidal flood levels have been used to determine the design of the development, so that the finished ground surface will be located above the design tidal flood level. Therefore, under normal operating conditions, no special measures would need to be undertaken.

Flood risk at the site should be periodically reviewed, and if considered necessary a Flood Evacuation Plan should be implemented, in accordance with the steps outlined below.

| Level Of Alert | Action |
|----------------|---|
| Pre-event | In areas served by Flood Alerts you should: <ol style="list-style-type: none"> i. Check the National Flood Forum or speak to a Floodline adviser to find out how to stay |

| | |
|--|---|
|  | <p>safe during a flood. Telephone: 0345 988 1188.</p> <ol style="list-style-type: none"> ii. Prepare a personal flood plan, community or group flood plan, or business flood plan. iii. If you own property next to a watercourse, for example a river, culvert, brook or mill stream, you must: <ul style="list-style-type: none"> • maintain river beds and banks (for advice speak to the NRW for guidance) not obstruct the water flow |
| <p>Flood Alert</p>  | <p>A flood alert means you need to prepare, flooding is possible. You should:</p> <ol style="list-style-type: none"> i. check your flood risk - https://flood-warning-information.service.gov.uk/long-term-flood-risk ii. sign up for flood warnings - https://www.gov.uk/sign-up-for-flood-warnings iii. keep up to date with the latest situation - call Floodline on 0345 988 1188 iv. or follow @EnvAgency and #floodaware on Twitter for the latest flood updates v. have a bag ready with vital items like insurance documents and medications in case you need to leave your home vi. check you know how to turn off your gas, electricity and water mains supplies plan how you'll move family and pets to safety |
| <p>Flood Warning</p>  | <p>A flood warning means you need to act, flooding is expected. You should do all the actions for a flood alert but also:</p> <ol style="list-style-type: none"> i. move vehicles to higher ground if it's safe to do so ii. move family and pets to safety iii. move important items upstairs or to a safe place in your property, starting with cherished items and valuables, then furniture and furnishings iv. turn off gas, electricity and water supplies if it's safe to do so; never touch an electrical switch if you're standing in water v. if you have property protection products such as flood barriers, or air brick covers, use them now vi. keep track of the latest situation - https://flood-warning-information.service.gov.uk/warnings |

Severe Flood Warning



A severe flood warning means there is danger to life: you must act now:

- i. call 999 if you're in immediate danger
- ii. follow advice from the emergency services and evacuate if you're told to do so
- iii. make sure you have an emergency kit including a torch, spare batteries, mobile phone and charger, warm clothes, important numbers like your home insurance, water, food, first aid kit and any medicines and baby care items you may need
- iv. alert neighbours and offer help if it's safe to do so
- v. avoid driving or walking through flood water: just 30cm (1 foot) of fast flowing water could move your car and even shallow moving water can knock you off your feet
- vi. keep your family and pets away from floodwater – it may contain heavy debris, sharp objects, open manhole covers, sewage and chemicals
- vii. wash your hands if you've been in contact with flood water which may contain toxic substances

8.9 Flood Evacuation Plan

If flood waters along the proposed evacuation route have exceeded 25cm, site users are advised, if possible, to seek refuge at the upper floors on site.

As with all Flood Evacuation Plans, in the first instance, all residents and occupants should always defer to, and cooperate with, the direction provided by "Blue Light Responders". This is especially true in areas which under normal circumstances would be protected by flood defences.

Once completed the development will be protected for tidal events of 200 year return period, for the next 100 years.

However, should the flood defences fail, or a flood event beyond the standard of protection designed for, then the site could be at risk of flooding. The occurrence of either or both of these events would pose a significant risk to people and property. There are a number of uncertainties associated with such an event, especially regarding flood depths and velocities, as well as the area impacted by the flood event. These uncertainties make it difficult to predict the most appropriate evacuation route.

Upon receipt of a Severe Flood Warning, the site should be evacuated along the designated route. All site users should be advised not to attend the site until the All Clear has been given. The Police, Fire Brigade and Emergency Planners will be the lead agencies in respect to flood evacuation.

In general, motorists should be aware of the dangers of driving in floodwater and should avoid driving in flooded areas.

No true 'safe escape route' (according to the specifications of the NPPF and FD2320) can be guaranteed if the site floods unexpectedly. However, dependent on flood depth, extent and severity, it may be possible to evacuate the site and leave the area by vehicle if evacuation is sought upon receiving an EA warning.

As the site has been designed to be protected from flooding, the safest course of action would be to remain within the buildings on the site. Unnecessary evacuations can place additional strain on blue light responders, whose resources would be best deployed servicing people and properties which pre-date modern flood risk management standards.

8.10 Impact to Flood Risk Elsewhere

The proposed development is not predicted to impact groundwater flows, and as such will not alter the groundwater flood risk in the area.

The Application Site is only at residual risk of flooding as a result of a breach in the proposed Tidal Flood Defences, coinciding with a peak tidal flood event. The proposed development would therefore not increase flood risk to others.

9 Conclusions

RHDHV has been appointed by Conygar Holyhead Ltd to support the application of a new Planning Consent for the proposed Holyhead Waterfront Regeneration Scheme.

This report has been written considering the requirements of Technical Advice Note 15 (TAN 15, 2004), Climate Change Allowances for Planning Purposes (2016), Flood Risk in Anglesey: Be Prepared (2013), Strategic Flood Consequence Assessment (Level 1, 2013), and the Statutory SuDS Guidance.

The Holyhead Waterfront Regeneration Scheme is a mixed-use regeneration project that is centred on a new leisure marina within Holyhead Harbour and encompasses residential, hotel, leisure, retail and commercial development and associated infrastructure.

This assessment has considered the potential impacts of climate change, based on the values attributable to the Western Wales River Basin District.

No records of historic flooding have been determined for the site.

The Development Advice Maps indicate that part of the Site is in Zone C2 and is therefore considered to be at risk of tidal/fluviol flooding. On the basis that the proposals are to set the development platform level to a minimum of 5.40mAOD (the 200 year return period tidal flood level in 2120), the development would effectively be at the still water level. Where waves appropriate, new crest walls would act as a new flood defence against wave action and the site would no longer be deemed to be within Development Advice Map Zone C2 and may be considered as complying with the conditions associated with Zone A.

TAN15 (A1.14) identifies that for residential uses these should be flood free during the 200 year return period tidal flood event, and therefore setting the development plateau level to this level. Adopting a precautionary approach finished floor levels of all buildings should be at least 150mm higher than the surrounding finished ground levels. All sleeping accommodation should be provided at least 600mm above the 200 year return period tidal flood event.

The NRW Risk from Surface Water Flood Mapping shows the site to contain discreet areas with high to low risk of surface water flooding, especially within the areas with existing buildings and hard standing. There are a number of surface water flow paths that drain into the site from higher ground to the south. These flow routes will need to be accommodated as part of the overall drainage strategy for the scheme.

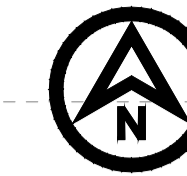
In order to provide adequate flood defence to the site, from the risk of tidal flooding, it is proposed to raise ground levels across the site. This would also provide adequate mitigation for the risk of groundwater flooding.

The risk of sewer flooding to the development is considered low, as is the residual risk of a breach or overtopping of the flood defences, and reservoir flooding. Due to the low risk attributable to these sources, no further flood mitigation measures are considered necessary.

As the site has extant planning permission the requirements to conform to the SuDS Adoption Body requirements do not apply.

Based on the proposed mitigation measures it is concluded that flood risk can be managed in accordance with the requirements of TAN15.

Appendix I - Drainage Strategy Drawing



- NOTES**
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
 - ALL LEVELS ARE IN METRES RELATIVE TO ORDINANCE DATUM NEWLYN (MOD). FOR RELATIONSHIP BETWEEN ORDINANCE DATUM AND CHART DATUM REFER TO DIAGRAM BELOW

KEY

- SURFACE WATER SEWER
- SURFACE WATER INSPECTION CHAMBER
- FOUL WATER SEWER
- FOUL SEWER MANHOLE
- PARKING

TIDAL INFORMATION

| STATE OF TIDE | LEVEL (mCD) | LEVEL (mOD) |
|---------------------------------|-------------|-------------|
| HIGHEST ASTRONOMICAL TIDE (HAT) | +6.30 | +3.25 |
| MEAN HIGH WATER SPRINGS (MHWS) | +5.60 | +2.55 |
| MEAN HIGH WATER NEAPS (MHWN) | +4.40 | +1.35 |
| MEAN SEA LEVEL (MSL) | +3.27 | +0.22 |
| MEAN LOW WATER NEAPS (MLWN) | +2.00 | -1.05 |
| MEAN LOW WATER SPRINGS (MLWS) | +0.70 | -2.35 |
| LOWEST ASTRONOMICAL TIDE | +0.00 | -3.05 |

| REV | DATE | DESCRIPTION | BY | CHK | APP | RA | GT | NC |
|-----|----------|-------------------|----|-----|-----|----|----|----|
| P01 | 18.06.21 | ISSUED FOR REVIEW | | | | | | |

REVISIONS

CLIENT

PROJECT
HOLYHEAD WATERFRONT DEVELOPMENT

TITLE
DRAINAGE PLAN



| DRAWN | RA | CHECKED | GT | APPROVED | NC |
|-------------|----------------------------|-------------|--------|----------|-----|
| DATE | JUNE'21 | SCALE | 1:1500 | REF. | |
| DRAWING No. | PB8908-RHD-ZZ-ZZ-DR-C-0075 | SUITABILITY | S2 | REVISION | P01 |

