



# Replacement Local Development Plan 2018-2033

## Background Paper

July 2019

**BP 35: Flood Risk and Development  
Opportunities**

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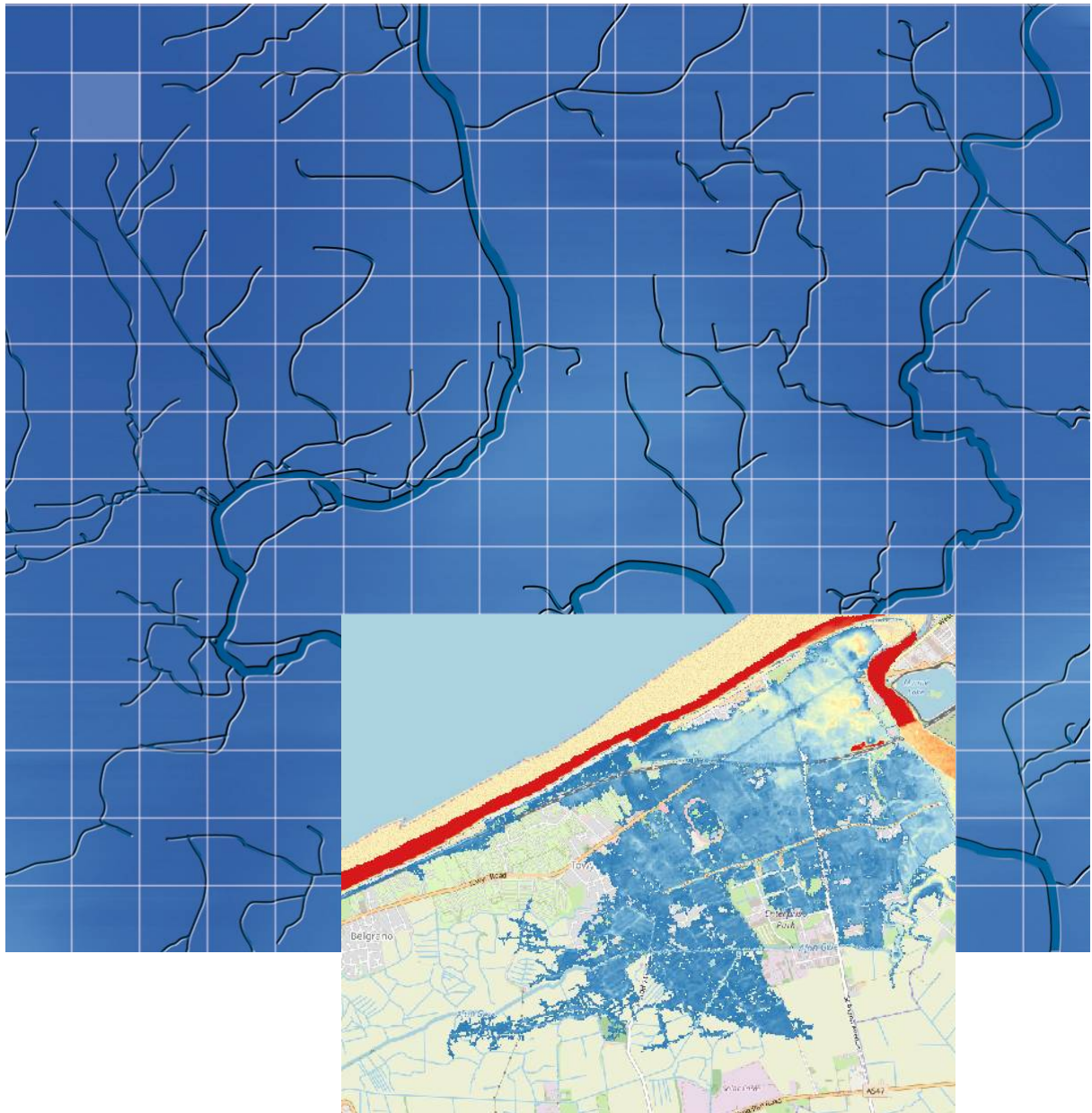
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Conwy County Borough Council

June 2019

# Pensarn to Kinmel Bay TAN15 Requirements



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### Document issue details

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1.1	07/06/2019	Final Draft	Alexandros Petrakis (Consultant)	Paul Blackman (Technical Director)

For and on behalf of Wallingford HydroSolutions Ltd.

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**Registered Office** Maclean Building, Benson Lane, Wallingford OX10 8BB  
**[www.hydrosolutions.co.uk](http://www.hydrosolutions.co.uk)**

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# 1 Introduction

## 1.1 Background

Wallingford HydroSolutions Ltd (WHS) has been commissioned by Conwy County Borough Council (CCBC) to undertake an assessment of likely TAN15 Flood Consequence Assessment requirements for new development between Pensarn and Kinmel Bay. This study is based on the existing Conwy Tidal Flood Risk Assessment (CTFRA) inundation modelling that was carried out by WHS and HR Wallingford in 2017. This study focuses on the Kinmel Bay, Towyn, Belgrano and Pensarn areas, being the principal areas at risk of flooding. The study location is displayed in Figure 1.

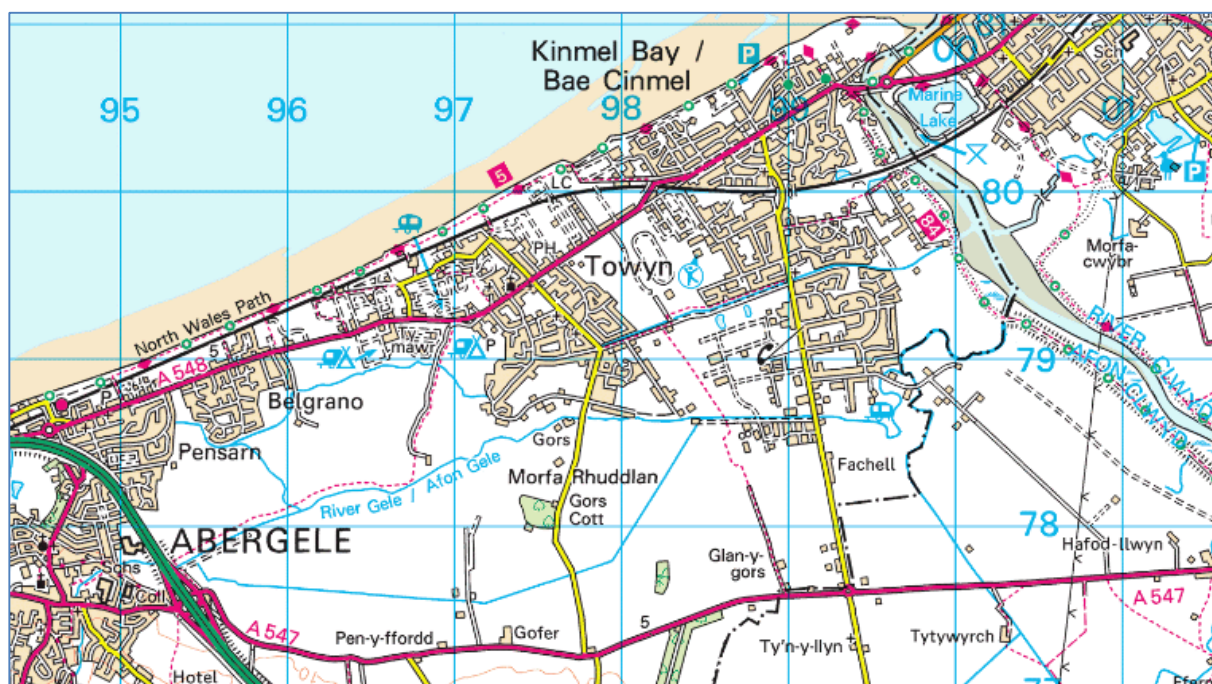


Figure 1 - Study Location

## 1.2 Scope

This study seeks to review several data sources to achieve the following aims:

- Understand general requirements for development in the area.
- Review past planning applications/objections to help inform requirements for development
- Assess flood risk to the area across several flood events, including risk from the coastal frontage and River Clwyd, including breaches
- Assess potential costs for defences using the draft Tidal Clwyd Strategy for the River Clwyd and current draft Outline Business Case (OBC) for the coastal frontage
- Qualitatively review benefits for development if defences were in place

### 1.3 Sources of Data

The main sources of data used to inform this study are listed below:

- Llanddulas and Kinmel Bay draft OBC<sup>1</sup>
- Natural Resources Wales (NRW) draft Tidal Clwyd Strategy<sup>2</sup>
- Technical Advice Note 15 (TAN15)<sup>3</sup>
- Email records of liaison with NRW
- NRW guidance note GN028<sup>4</sup>
- Existing planning refusals supplied by CCBC
- JBA Consulting Point of Ayr to Pensarn Modelling Study<sup>5</sup>

### 1.4 Assumptions

The main assumption of this study is that, at this stage, the Clwyd Strategy and hydraulic model as per 2011 have been utilised. It is understood that this is currently being updated by NRW, however has not been attainable in time for the issue of this interim note. An updated version of the Clwyd model has however been made available within the Point of Ayr to Pensarn modelling study (2017).

## 2 Requirements for Development

In order to understand the requirements for development in this flood risk area, TAN15 was reviewed alongside liaison with NRW to identify any local/more specific guidance to be considered in conjunction with TAN15.

### 2.1 TAN15

Development in Wales is driven by the Development Advice Map (DAM), which assigns each area of land a zone classification based on its likelihood of flooding and protection from flood defences. The table below summarises the DAM Zone classifications.

**Table 1 - DAM Zones**

DAM Zone	Description
A	Little or no risk of flooding
B	Areas known to have been flooded in the past
C1	Served by significant infrastructure, including flood defences.
C2	Floodplain without significant defence infrastructure

<sup>1</sup> Draft Llanddulas and Kinmel Bay OBC. Outline Business Case. March 2019. Version 1.0. Conwy County Borough Council.

<sup>2</sup> Draft Strategy Appraisal Report. Environment Agency Wales. Tidal Clwyd FRMS. August 2011. Version 3.

<sup>3</sup> Planning Policy Wales. Technical Advice Note 15: Development and Flood Risk. Welsh Assembly Government. July 2004.

<sup>4</sup> Guidance Note GN028. Modelling for Flood Consequence Assessments. Natural Resources Wales. Version 4.0. July 2018.

<sup>5</sup> Point of Ayr to Pensarn Tidal Flood Risk Analysis. Final Model Development Report. JBA Consulting. December 2017.

Large parts of the study area are classified as Zone C1 due to the existing defences along the coastal and tidal Clwyd frontage. Areas within the vicinity of the Clwyd and a small area of land north of Lane End Farm lie in C2.

The aim of TAN15 is to provide guidelines as to what consequences of flooding are appropriate for particular types of development. Section 5 splits land use into development vulnerability types. Residential development falls under the “highly vulnerable” category, as do public buildings such as schools. Highly vulnerable development is not permitted within DAM Zone C2. Commercial and retail development falls under the “less vulnerable” category. See section 5 of TAN15 for further detail.

### 2.1.1 Table A1.14

This section refers to allowable frequency thresholds of flooding for different types of development. The probability of flooding is given as a percentage, which refers to the chance of flooding in any given year. This information is shown below in Table 2. Please note that as well as the frequency thresholds, climate change should be considered over the lifetime of the development e.g. 100 years for residential development.

**Table 2 - Threshold frequencies of flooding**

Type of development	Threshold Frequency (%)	
	Fluvial	Tidal
Residential	1.0	0.5
Commercial	1.0	0.5
Industrial	1.0	0.5
General Infrastructure	1.0	0.5
Emergency Services	0.1	0.1



### 2.1.2 Table A1.15

Beyond the design event, properties are expected to flood in more extreme flood events e.g 0.1% Annual Exceedance Probability (AEP) event. Section A1.15 of the TAN suggests some indicative parameters that represent acceptable flood consequences. Please note that the parameters should be reviewed on a case by case basis and are not prescriptive.

**Table 3 - Flood parameters for more extreme events**

Development Type	Maximum depth of flooding (mm)	Maximum Rate of Rise (m/hr)	Maximum Speed of Inundation (hrs)	Maximum Velocity (m/s)
	Property			Property
	Access			Access
Residential	600	0.10	4	0.15
	600			0.30
Commercial	600	0.30	2	0.15
	600			0.30
Industrial	1000	0.30	2	0.30
	1000			0.45
General Infrastructure	600	0.30	2	0.30
	600			0.30
Emergency Services	450	0.1	4	0.15
	600			0.30

### 2.1.3 Justification Test

For highly vulnerable or less vulnerable development in DAM Zone C1, development must be shown to meet the requirements of the Justification Test through a site-specific Flood Consequences Assessment (FCA). The justification test outlines the following criteria:

- Its location in Zone C is necessary to assist a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or,
- Its location in zone C is necessary to contribute to key employment objectives supported by the local authority; AND,
- It concurs with the aims of PPW and meets the definition of previously developed land; and,
- The potential consequences of a flooding event for the particular type of development have been considered and found to be acceptable.

## 2.2 Liaison with NRW

Advice was sought from NRW to obtain local knowledge and any more specific requirements for development in the study area. The full record is available as Appendix 1 and has been summarised below:

- New development will need to consider climate change over the lifetime of the development, with the design event for all development apart from emergency services being the 0.5% AEP event from coastal/tidal sources of flooding.
- FCA's will need to consider the likelihood of defence breach and include a suitable buffer zone behind susceptible defences where no development should take place, in accordance with paragraph A1.7 of TAN15.
- Land raising can be considered as an appropriate mitigation, providing that there are no unacceptable third-party impacts on flood risk.
- Third party impacts should be assessed to two decimal places i.e. rounded to the nearest 10mm<sup>4</sup>.
- Tidal estimate uncertainties should be used to set Finished Floor Levels (FFL's), using climate change values for the development lifetime (e.g. 100-years for residential). In the absence of this, a freeboard is likely to be recommended of up to 600mm above the design flood level.

## 2.3 Review of Previous Planning Applications

Several planning applications have been provided by CCBC for WHS review to identify the main issues related to flood risk and planning in the area. Five case studies were provided. The following issues were observed:

- NRW have raised concerns over land raising and its implications for flood risk on third party land. From the correspondence with NRW it appears that the land raising and its effect on flood risk was not assessed quantitatively. It is likely that modelling will be required to determine the level of impact.
- Access/egress routes were shown by the hydraulic model to flood to depths that far exceed those stipulated in table A1.15 of TAN15, which raised significant concern.
- NRW supported the approach of development occupiers signing up to the flood warning service and preparing an emergency flood action plan.
- Significant concerns were raised in relation to A1.14 compliance, with development flooding by several metres including future sea level rise due to climate change.
- Concerns were raised over the amount that flood defence breaches can exacerbate flood depths, particularly the Clwyd earth embankments as these were built on relatively unstable ground. Breaches should be taken into account when considering A1.14 and A1.15 compliance.

## 3 Flood Risk in the Area

The main flooding mechanisms in the study area are wave overtopping at the coastal frontage and tidal overtopping of the defences on the River Clwyd. Fluvial flood risk from the River Clwyd is not assessed as part of this interim note as model data are not available. There may also be local fluvial flood risk associated with smaller watercourses in the floodplain, but these are not assessed as part of this study.

### 3.1 Conwy Tidal Flood Risk Assessment (CTFRA)

The CTFRA study was completed by WHS in 2017. This combined the latest overtopping calculations carried out by HR Wallingford and inundation modelling carried out by WHS. The modelling assumes worst case storm conditions for each section of defence along the frontage and assumes that

overtopped water does not drain away (e.g. through highway drainage). A range of flood events have been considered and are presented below.

### 3.1.1 0.5% AEP Present Day (no breach)

Flooding in this event covers large parts of Kinmel Bay and eastern parts of Towyn. The flood extent falls short of the A547 road by approximately 500m. Large parts of the Belgrano and Pensarn areas are shown to be dry. Flood depths in the floodplain at Kinmel Bay are shown to be in the region of 0.40-0.60m south of the railway line, increasing to 0.80-1.20m north of the railway. Flood depths in Towyn are slightly less at around 0.20-0.40m. The flood extent and depth are displayed in Figure 2. Velocities are in the region of 0.20-0.60m/s in the eastern part of Towyn and in Kinmel Bay. South of this, velocities reduce to 0.10-0.30m/s.

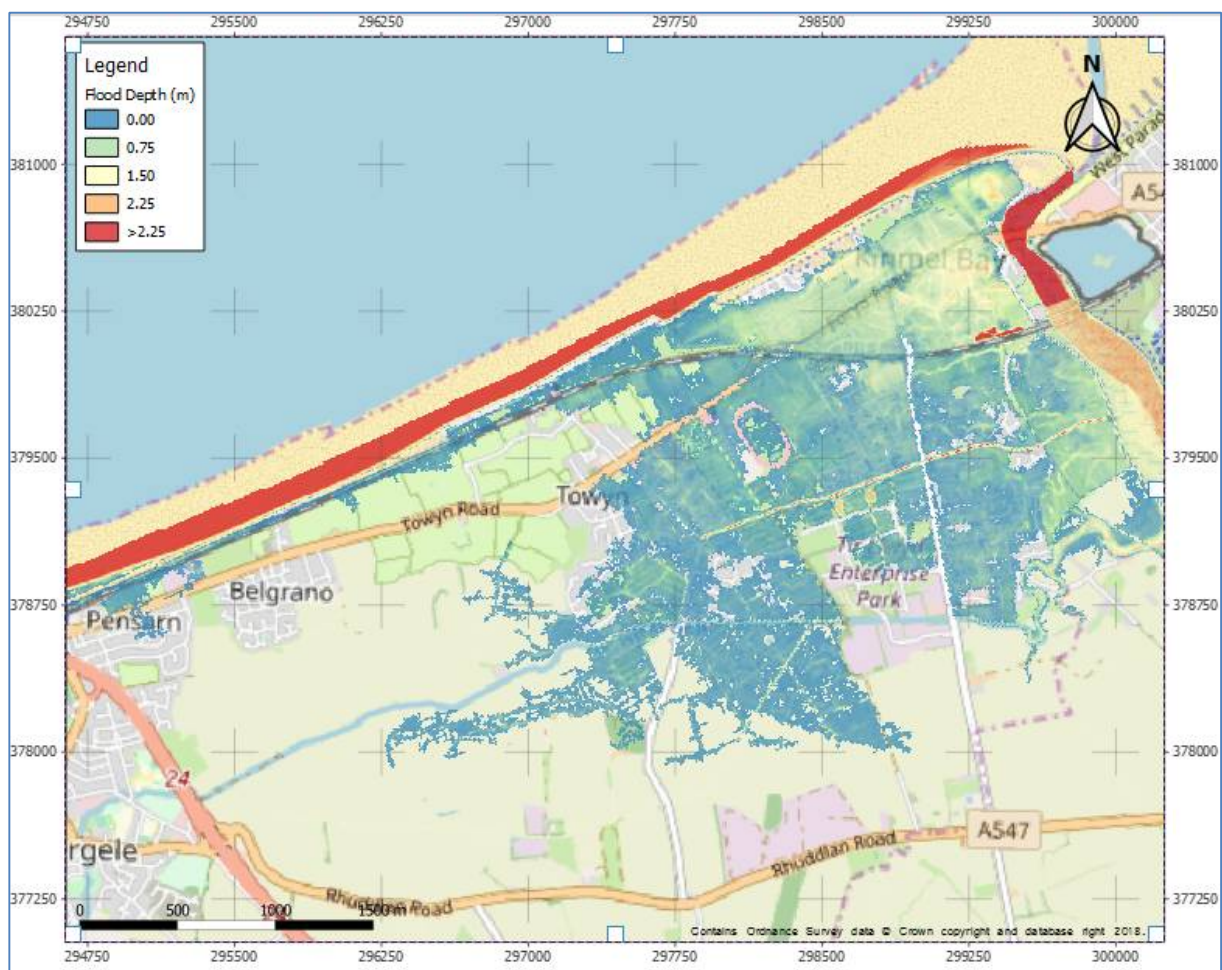


Figure 2 - 0.5% AEP Present Day Flood Depths

### 3.1.2 0.5% AEP with 100yrs Climate Change (no breach)

Large parts of the floodplain are inundated during this scenario, with the flood extent shown to reach beyond the A547. There is a large parcel of currently open land that remains dry south of Towyn (labelled in Figure 3). This occupies an area of approximately 20ha. Flood depths in the Pensarn area are generally between 0.30-0.50m. Moving east at Towyn, flooding is mostly 0.40-0.70m deep. South of the railway at Kinmel Bay, depths are approximately 0.80m-1.00m. Heading south toward the A547 depths reduce to mostly between 0.30-0.50m. This is also labelled below in Figure 3.

Velocities throughout Kinmel Bay are largely around 0.40-0.80m/s, reducing to the west to 0.40-0.80m/s at Towyn. To the south they are in the region of 0.20-0.60m/s. Note that there is significant uncertainty when assessing overtopping rates for the climate change scenario due to the relatively high predicted tide levels compared to defence heights.

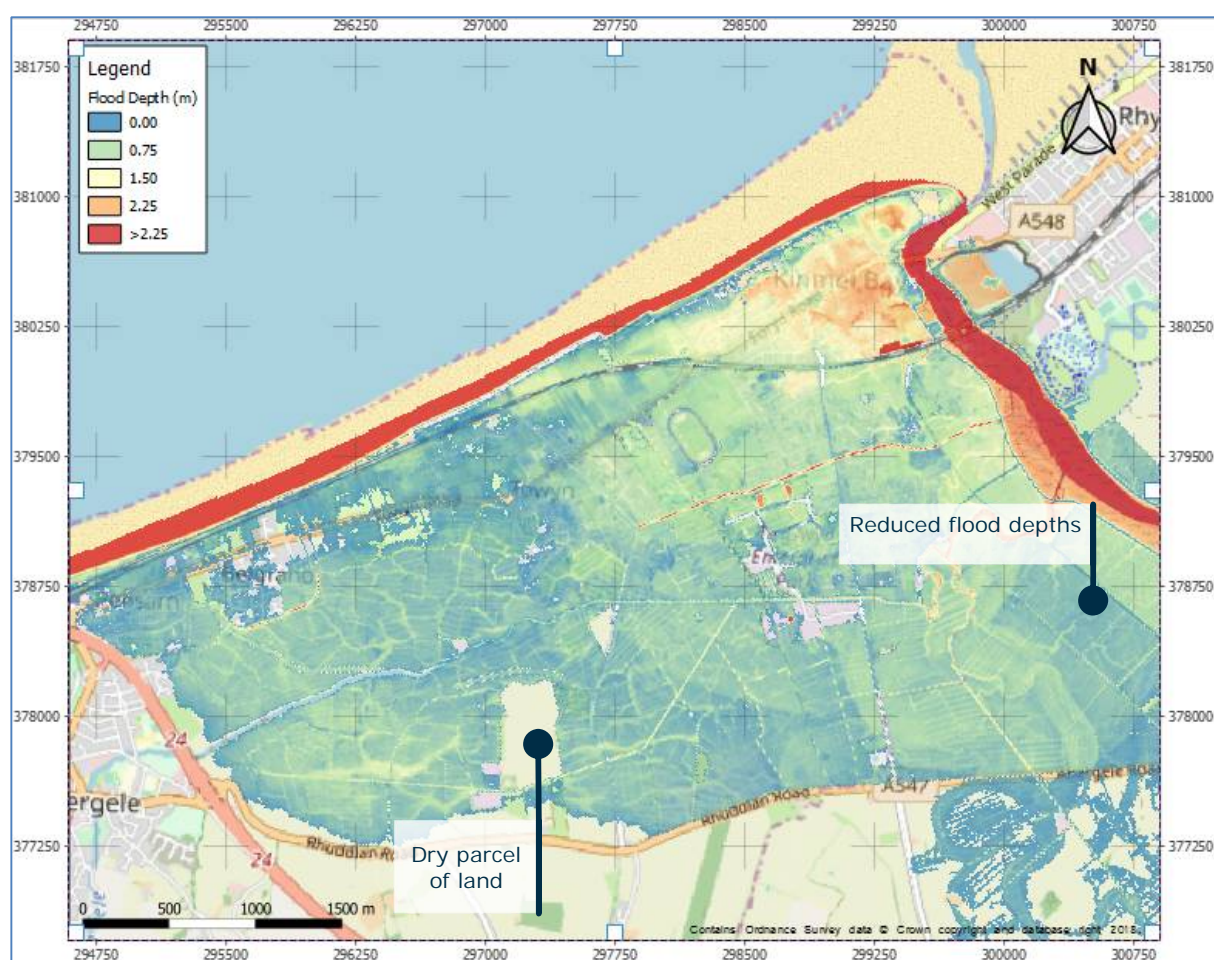


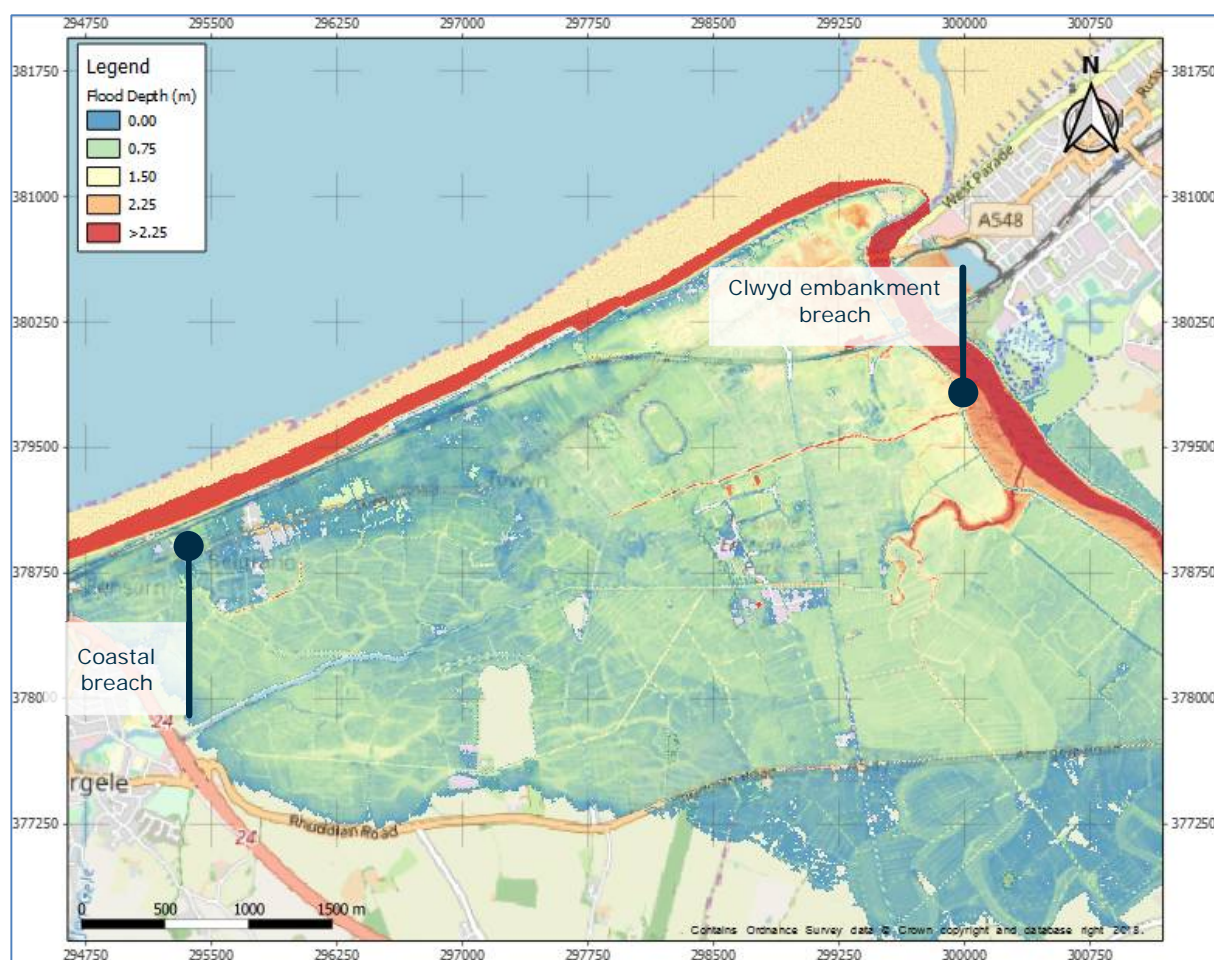
Figure 3 - 0.5% AEP with 100yrs of climate change flood depths



### 3.1.3 0.5% AEP with 100 years of Climate Change and Breach

As part of the CTFRA, breaches were modelled at the coastal frontage and along the Clwyd embankment. These were breached down to existing ground levels and coincided with peak water levels, remaining breached for three tidal cycles. During the breach scenario, flood depths increase by approximately 0.20 and reach in excess of 1m in places. Land north of Towyn Road experiences smaller depths that range from 0.20-0.40m. This area currently appears to be occupied by a caravan park according to aerial imagery. At Pensarn, flood depths reach 0.90m but are more commonly at approximately 0.60m. The flood depths are shown in Figure 4.

Velocities during a breach reach 1m/s in spots throughout Belgrano and Towyn, however are more commonly at 0.5m/s. Velocities are similar in the Kimel Bay area, however reach up to 2m/s at existing ditches.



**Figure 4 - 0.5% AEP with 100 years of climate change and breaches**

### 3.1.4 Summary

Large parts of the floodplain are shown to be inundated in the 0.5% AEP event including climate change, with flood depths being further exacerbated by breaches in existing flood defences. The flood depths, particularly north of the railway line in Kinmel Bay are in excess of 1m and would therefore require substantial ground raising to become compliant with TAN15 when including a freeboard allowance. It will also need to be demonstrated that land can be raised without affecting flood risk to third parties. Flow velocities across some areas of the floodplain are higher than the indicative guidance in A1.15 of TAN15 for residential when considering climate change, however not in all areas, particularly when progressing further west. Velocity requirements for less vulnerable development are also higher so development in some areas would be appropriate in the baseline scenario on this basis. It is noted however that the guidance in A1.15 is not prescriptive and should be reviewed on a case by case basis.

### 3.2 Clwyd Strategy

The tidal Clwyd model is currently being updated by NRW, however for the purpose of this study the model outputs as of its last update (2011) have been reviewed. Whilst the River Clwyd was not specifically modelled as part of the CTFRA, the Clwyd Strategy includes a more detailed assessment of the channel's capacity using surveyed river sections and models the effect of structures. However, the modelling has been completed using out of date software. As a comparison, the model shows flooding to be exacerbated when looking at the 0.5% AEP with climate change event. Depths across the floodplain in Kinmel Bay are generally around 1.0-1.2m.

### 3.3 Point of Ayr to Pensarn Study

A modelling study was completed by JBA Consulting in 2017 which includes an updated Tidal Clwyd model that is linked to an inundation model of flood risk from the open coast. The coupled model accounts for flood risk from high tidal water levels weiring over the Clwyd Embankments as well as the risk from wave overtopping and still water inundation along the open coast. The non-coupled model does not include the risk from the Clwyd and shows the risk from coastal flooding only.

The model results show that the risk to the Kinmel Bay area is significantly increased when considering the weiring of high tidal water levels over the Clwyd embankments. Please see Figure 5 for a comparison between these flood extents. During a 0.5% AEP event with 100-years of climate change, flood depths are similar to those shown by the CTFRA study, with depths at Kinmel Bay largely falling within the 0.70-1.30m category. Velocities are shown to be largely below 0.4m/s, however peak at 1m/s or above at key surface water flood routes such as ditches and some lower roads.

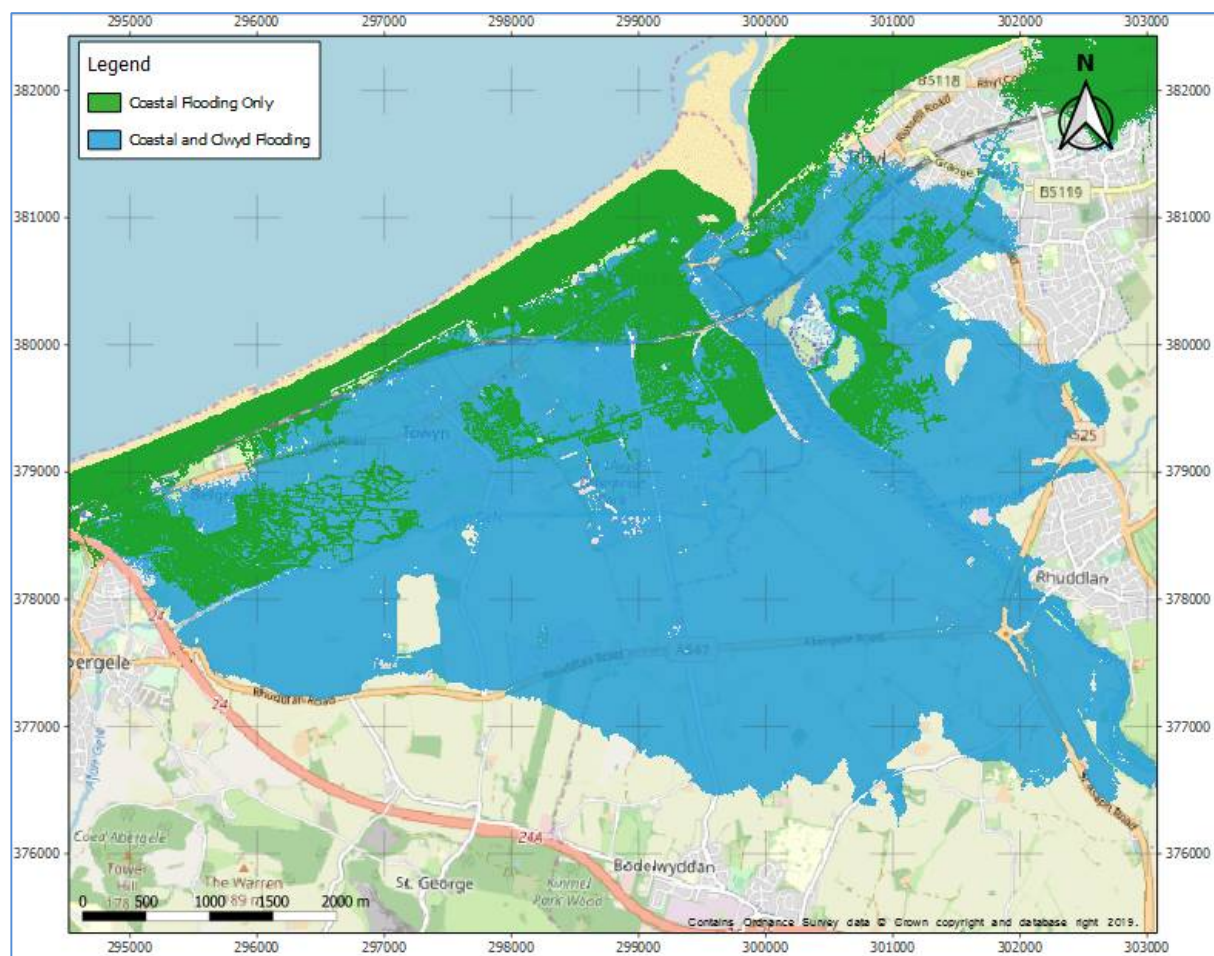


Figure 5 - Comparison between coastal flooding vs coastal and Clwyd flooding: 0.5% AEP event with 100-years of climate change

## 4 Site Assessment

As part of this study, the current flood risk based on the CTFRA modelling data has been assessed at a brownfield site off of Gwellyn Avenue in the Kinmel Bay area (NGR: SH 99393 78794). The depths and velocities have been reviewed over 3 key events to identify the constraints to residential development at this location. NRW have also been contacted to gain their initial opinion and criteria for development at this specific site. The flood parameters extracted from the model data are summarised in Table 4. The site boundary is shown in Figure 6.

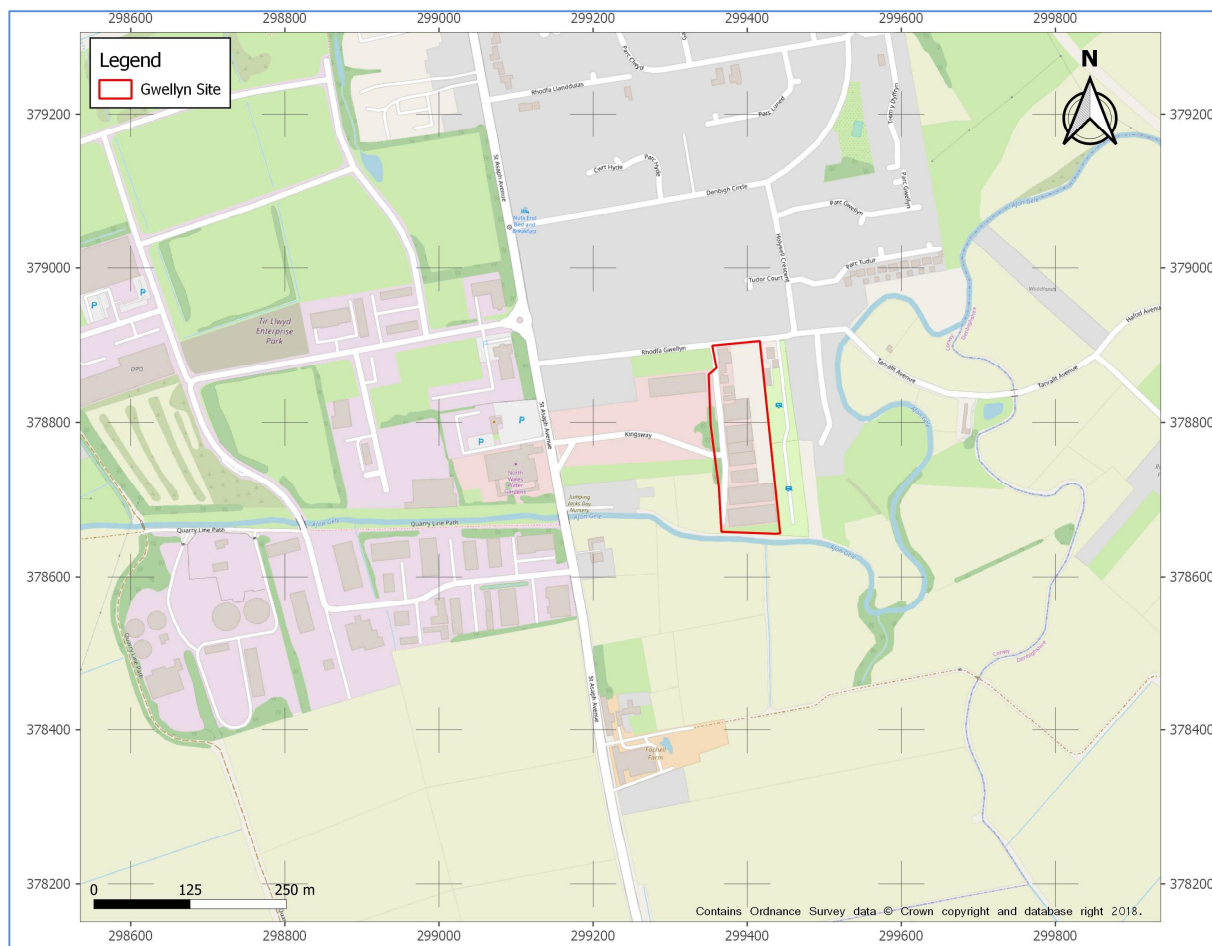


Figure 6 - Gwellyn Site

Table 4 - Flood parameters at the site off of Gwellyn Avenue

AEP Event (%)	Average Depth (m)	Average Velocity (m/s)
0.5	0.20	0.10
0.5 plus climate change	0.55	0.25
0.5 plus climate change AND breach*	0.70	0.25

\*Design event as specified by NRW



As the development is brownfield, it meets part of the requirements of the justification test, in that it meets the definition of previously developed land. However, the justification test also refers to ensuring that there are no impacts of development on third party land.

Based on the guidance received from NRW on the design event, a minimum of 0.70m of ground raising would be required and could be in excess of 1m depending on the freeboard analysis. This will displace floodwater and is likely to provide some level of impact to surrounding land/development. As the site is currently brownfield containing built development, it is likely that the largest issue with regard to impacts offsite would be storage associated with land raising rather than conveyance, which has the potential to compromise developable area if mitigation is required. The impacts would need to be assessed through modelling to confirm whether mitigation is required.

## 5 Potential Flood Defence Costs

### 5.1 Coastal Frontage

The current preferred option along the 11km coastal frontage as a result of the draft Llanddulas and Kinnel Bay OBC (2019) includes raising of the existing seawall crest height, enhanced rock revetment and periodical beach recharge at Kinnel Bay. At Pensarn, a setback flood wall is proposed, with rock revetment seaward of the existing wall at Belgrano to the east. As part of the OBC, cost estimates have been produced, which are summarised below in Table 5. Please note that these costs include maintenance over a 100-year period. The scheme is expected to protect 4363 residential properties from flooding during a 1.0% AEP event with 100-years of climate change. An image showing the flood extent with the preferred option in place for the 0.5% AEP event (present day) is presented below.

Table 5 - Coastal frontage defence costs

Installation (£)	Maintenance (over 100 years) (£)	Other (Rhyl Harbour Wall) (£)	Total (£)
22,052,770	41,502,835	5,787,000	69,342,605



Figure 7 - 0.5% AEP event with preferred option at coastal frontage

## 5.2 Draft Clwyd Strategy (2011)

The preferred option for the Tidal Clwyd as a result of the draft 2011 study is to take the “hold the line” in the form of managed re alignment by moving defences further away from the river, with a 0.5% AEP standard of protection. The new embankments will include protection for 50-years of sea level rise, with the costs including an amount for raising the embankments again after this 50-year period to account for sea level rise up to the 100-year appraisal period. The scheme is expected to protect 5,523 properties from flooding in the Clwyd West region. The EA Present Value (PV) costs associated with this for the Clwyd West area, which covers the study area are presented in Table 6.

**Table 6 - Clwyd strategy costs for Clwyd west**

Fluvial (£)	Tidal (£)	Total (£)
4,617,000	24,862,000	29,479,000

## 6 Conclusion

This interim note has considered the flood risk from both wave overtopping and tidal events and their implications for development, based on the best available data at the time of writing. Several data have also been collated and reviewed to outline the requirements for development in the region. Additionally, the capital costs for installation and maintenance of new defences to protect the area from flooding along the coastal frontage and tidal Clwyd have been summarised. The following conclusions can be made at this stage:

- Development should be dry in the 0.5% AEP event including consideration of climate change.
- An assessment of breach should be included as part of a site specific FCA.
- Tidal uncertainties should be used to design FFL's. In the absence of this a freeboard will be required as agreed with the regulator, up to 600mm.
- Ground raising is a feasible form of mitigation; however, it should be demonstrated that there are no impacts to third parties.
- Flood depths across the floodplain are in excess of 1m north of the railway line at Kinmel Bay. South of the railway flood depths reduce. There are minimal areas that are flood free at existing ground levels during the design event.
- Flow velocities in the floodplain when considering climate change are largely around 0.4m/s, however, do surpass this value locally.
- Breaches along the Clwyd and coastal frontage generally lead to deeper flooding by approximately 0.20-0.30m.
- The coupled model used in the Point of Ayr to Pensarn Study shows flood depths in the floodplain to be comparable with those predicted by the CTFRA model.
- The brownfield site off of Gwellyn Avenue is shown to flood to depths of approximately 0.70m during the design event. In the event that this site should be considered for development prior to an improvement in the flood defences, ground raising and appropriate mitigation will need to be considered if required.
- Defences along the coastal frontage and tidal Clwyd will result in significant betterment, making several thousand properties safe from flooding that are currently within the flood extent.

## Appendix 1 – NRW Liaison

All new development proposals should be designed to meet the appropriate design threshold frequency of flooding, including an allowance for climate change (and flood defence breach), set out in table A1.14.

There may be specific local situations where a developer is able to demonstrate that flooding to certain parts of a site within the red line boundary could be tolerable, for example ‘ancillary areas’.

The developer must demonstrate that all options to design the development to be entirely flood free have been explored and exhausted.

Flooding within the red line development site boundary will only be considered where:

- All properties and /buildings, residential car parking areas and adjacent garden areas should be designed to be flood free.
- Flood depths to ‘ancillary areas’ do not exceed **+300mm** for the minimum design threshold frequency in table A1.14 (plus an allowance for climate change over the lifetime of the development).
- With the exception of clearly designated ‘flood storage/conveyance areas’, the flood hazard rating is no greater than ‘very low’ in accordance with the established Defra FD2320 hazard guidance (supplementary note)<sup>4</sup> using depth and velocity (see Table 1). Flood hazard greater than this may result in an unacceptable risk (dependant on the type/location of the development proposal).
- There is no risk of increased flooding elsewhere.

Should land raising be an option be proposed for sites then the impact elsewhere would need to be considered.

Increase to 3<sup>rd</sup> parties due to a development proposal in a flood risk area is not acceptable.

For the purpose of this guidance, ancillary areas include:

- Open spaces/recreational areas
- Designated flood storage/conveyance areas
- General use car parking areas (non-residential)
- Internal estate roads designed for the purpose of flood conveyance.

### Using tidal uncertainty values

We recommend that as best practice, developers/consultants assess their proposals against the following event as a ‘sensitivity test’. This is recommended to help futureproof the development against flood risk:

- 0.5% AEP sea level, *plus uncertainty*, plus an allowance for climate change over the development lifetime.

We recommend that outputs from the sensitivity test assessment are used to inform development design, for example setting of floor levels.

In the absence of a sensitivity test, we would be likely to recommend a ‘freeboard allowance’ is included to minimise flood risk to the development, for example raising floor levels 600mm above the design flood level.



The defences affording protection to the Pensarn to Kinmel Bay area need to consider failures/breach as the design event and not a residual risk due to:

- Long-term settlement of Clwyd embankments, due to poor ground conditions, could result in some reduction in standard of protection offered by the defences.
- Impacts of climate change and sea level rise will increase likelihood of overtopping of the defences. The tidal Clwyd earth embankments would be prone to scour and erosion, and hence failure, during overtopping conditions. Other physical processes, such as piping, could increase likelihood of defence failure.
- Tidal Clwyd Strategy and SMP are “high level” strategic documents, that do not secure funding for long-term improvements to the flood defences, so no guarantee defence improvements to deal with climate change impacts.
- The probability of failure of the coastal defences as previously discussed and assessed as part of the CTFRA.