Watfore Ltd.

Creamfields Residential Development

Flood Risk Assessment

252666-00-RPT-FRA-SHD

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Job number 252666-00

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1 Introduction

Watfore Limited. intend to apply to An Bord Pleanála (the Board) for permission for a Strategic Housing Development on lands located at the former "CMP Dairies" site at Kinsale Road / Tramore Road, Cork.

The proposed development will consist of a Strategic Housing Development of 609no. dwellings (561no. apartments (of which 257no. are Build To Rent) and 48no. townhouses) in 12no. buildings of between 1-15 storeys in height over ground, to include a coffee kiosk; gym; café; retail use; creche and community hub; public square; car parking; cycle parking; and all associated site development, infrastructural, and landscaping works on the site of the former CMP Dairies site, Kinsale Road and Tramore Road, Cork.

This Flood Risk Assessment (FRA) report assesses the flood risk to the proposed development. The FRA has been undertaken in accordance with 'The Planning System and Flood Risk Management' Guidelines for Planning Authorities published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DEHLG).

Extracts of the site plan for Level 0 and Level 1 of the proposed development are presented in Figure 1 and Figure 2.

Figure 1: Extract of Site Layout – Level 0. Not to scale.

Figure 2: Extract of Site Layout – Level 1. Not to scale.

2 Flood Mechanisms and Historic Flooding at the Site

2.1 Existing Site

The site is a brownfield site located at the junction of Tramore Road and Kinsale Road on the south side of Cork City (Figure 3).

Figure 3: Site Location

Access to the site is from the existing gated entrance to the north of the site on the Tramore Road. The site generally falls in a north to south direction from a level of circa 12.5m at the Tramore Road entrance at the north to a low of circa 6.0m at the southern of the site.

The existing site is currently overlaid with large areas of hard standing and stoned areas.

2.2 Potential Flood Mechanisms at the Site

The following potential sources of flood risk have been assessed as part of this Flood Risk Assessment:

- Fluvial flooding (river) – There is a risk of fluvial flooding during high flows in the Tramore River;

- Tidal flooding – There is a risk of tidal flooding to the general Douglas area during surge events in Cork Harbour;
- Pluvial flooding/urban drainage – Pluvial flooding may occur when the capacity of the local surface water drainage network is exceeded during periods of intense rainfall;
- Groundwater flooding – Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during late winter/early spring when the groundwater table is already high. If the groundwater level rises above ground level, it can pond at local low points and cause periods of flooding;

2.3 Historic Flood Data

Records of historic fluvial and tidal floods were obtained from the OPW National Flood Hazard Mapping website (www.floodmaps.ie). An extract from the National Flood Hazard Mapping website report summary, indicating the locations of recorded flood events in the vicinity of the site, is presented in Figure 4.

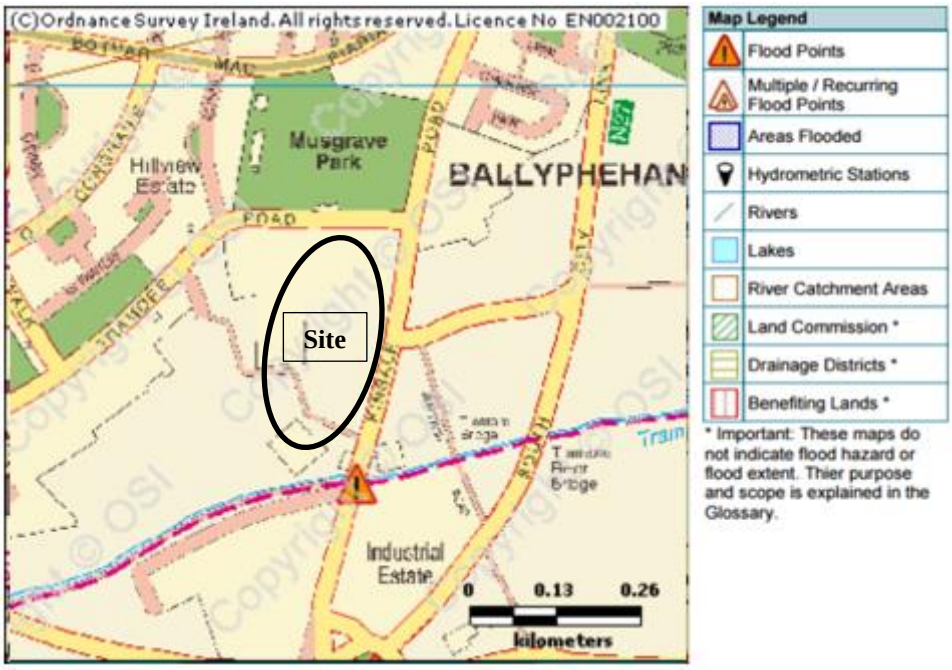

Figure 4: Extract from the National Flood Hazard Mapping website summary report

Two reports are presented on the National Flood Hazard Mapping website and these refer to flood events that occurred on January 2009 and December 2009.

2.3.1 January 2009

A flood event occurred on 30 January 2009 west of our site near the Kinsale road roundabout, but we note that this event is not relevant , nor did it have an affect on the site, therefore it has not been considered further within this report.

2.3.2 December 2009

A flood event occurred on Wednesday 30 December 2009 along the Tramore River in the vicinity of the site. A number of industrial units in the vicinity of the site were affected by the event and a section of the local road for a length of approximately 100m was also flooded.

A blockage occurred at the bridge over the Tramore along the Kinsale Road circa 80m from the southern boundary of the site which caused water to escape the channel upstream of the bridge.

The maximum observed flood level along the Tramore in the vicinity of the site was 6.05m (OD Malin). As this level is marginally higher than some sections of the southern area of the site it is possible that a very small area of the southern section of the site may have been inundated during the event. The majority of the site however lies above this recorded flood elevation and was not inundated during the event.

3 Existing Flood Risk

3.1 Fluvial Flood Risk

3.1.1 Lee CFRAMS Study

The final hydraulic report and final predictive flood mapping from the Lee Flood Risk Assessment and Management Study (Lee CFRAMS) have been assessed as part of this FRA.

The Lee CFRAMS fluvial flood extent map for the 10, 100 and 1000-year events in the vicinity of the subject site is presented in Figure 5. The labels in the figure correspond to the cross sections of the hydraulic model and trace the centre line of the Tramore river.

It is noted that the background imagery of the map suggests that a building is present on the site. We note that this building has been demolished.

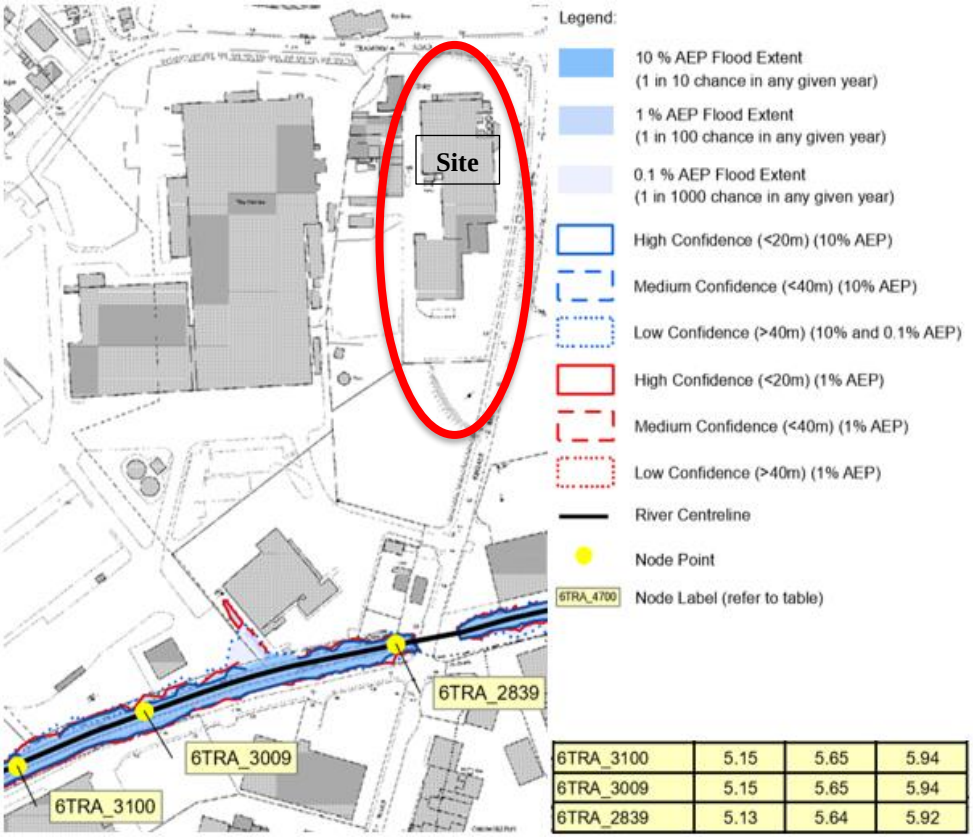

Figure 5: Tramore Flood extent map for the 10, 100 and 1000-year return period flood-fluvial event.

It can be seen from Figure 5 that the subject site is not indicated as being within the modelled 10, 100 or 1000-year fluvial floodplain. The predicted maximum water level for the 100-year event at the cross sections most relevant to the subject site (6TRA_3009 and 6TRA_2839) are 5.65mOD and 5.64mOD. These levels are circa 0.2m below the existing ground levels along the southern border of the site and circa 1m below most of the area of the site.

The risk of fluvial flooding to the site is therefore considered to be very low.

3.2 Tidal Flood Risk

The Irish Coastal Protection Strategy Study (ICPSS) provides predicted tidal flood extents and design water levels in coastal areas around Ireland.

The predicted 200-year design tidal water level for Lough Mahon is 2.89mOD (Table 1). As this is circa 3m below existing ground levels at the site the risk of tidal flooding to the site is considered to be remote.

Table 1: Summary of ICPSS tidal water levels for Lough Mahon

Node label	**Water Level (mOD)**		
	1 in 10 year	1 in 200 year	1 in 1000 year
C_3	2.60	2.89	3.04

3.3 Pluvial Flooding

Pluvial flooding occurs when extreme rainfall overwhelms drainage systems or soil infiltration capacity, causing excess rainwater to pond above ground at low points in the topography.

Figure 6 presents the PFRA flood mapping produced by the OPW. It can be seen from the figure that the risk of pluvial flooding to the site is low. It is however noted that water has been observed to pond immediately inside the southern boundary of the site.

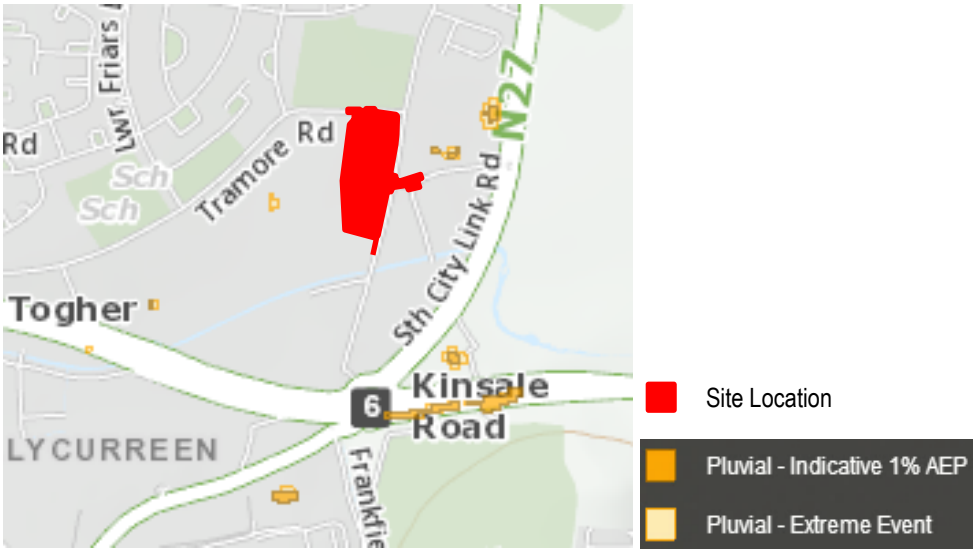

Figure 6: PFRA mapping for the subject site. The subject site is indicated in red.

3.4 Groundwater Flooding

Groundwater Flooding can occur during lengthy periods of heavy rainfall, typically during late winter/early spring when the groundwater table is already high. If the groundwater level rises above ground level, it can pond at local low points and cause periods of flooding.

The Groundwater vulnerability mapping for the site is presented in Figure 7. It can be seen from the figure that the vulnerability of the groundwater is classed as "Moderate" at the site which suggests that either the water table is relatively high and/or permeable soil surface. This dataset however is only indicative and does not fully reflect the risk of groundwater flooding of the site.

The risk of groundwater flooding to the site is considered to be low given the absence of historic flooding at the site and the existing ground levels which slope North South at the site.

It is recommended that groundwater levels at the site are monitored and a more detailed assessment of the groundwater flood risk is undertaken as part of any future development of the site.

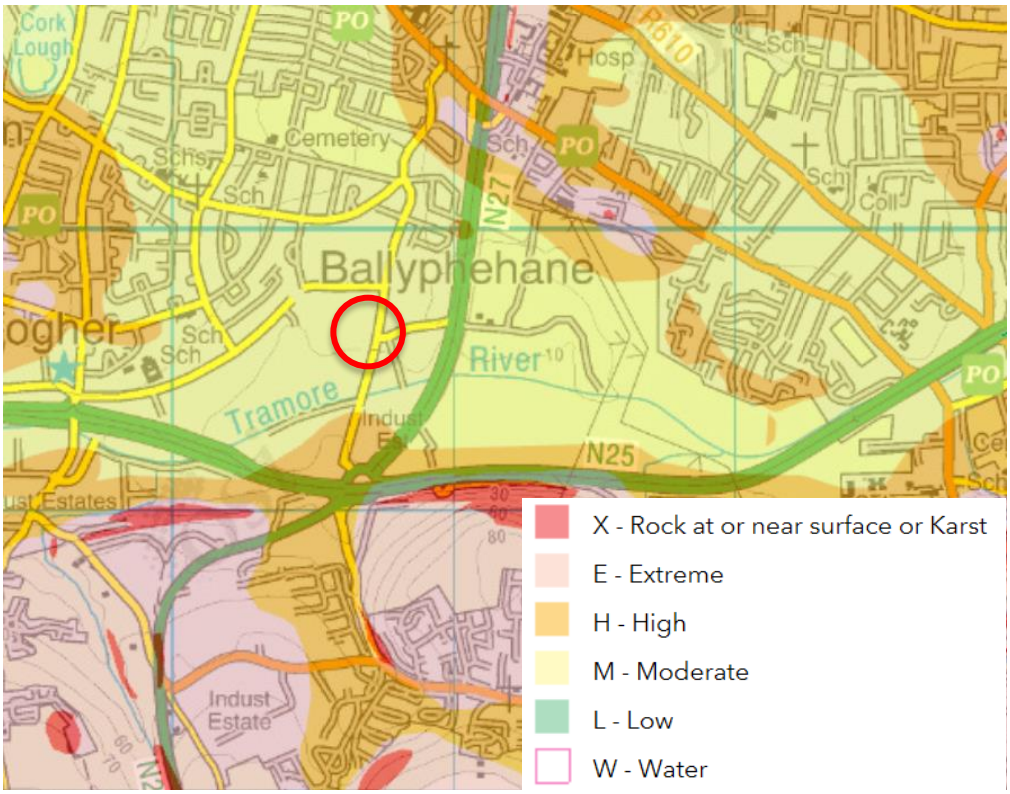

Figure 7: Groundwater vulnerability mapping.

3.5 Summary of Existing Flood Risk

The risk of flooding to the site is summarised as follows:

- The risk of fluvial flooding to the site is considered low;
- The risk of tidal flooding to the site is considered low;
- The risk of pluvial flooding to the site is considered low;
- The risk of groundwater flooding to the site is considered low.

4 Establishment of a Site Design Flood Levels

4.1 Proposed Design Flood Level

As established above, the predicted 1 in 100 year fluvial levels in the vicinity of the site is 5.65mOD.

4.2 Climate Change

Future climate change is predicted to result in several effects, including more extreme rainfall, more severe floods, and an increase in mean sea level.

In Ireland, current OPW draft guidance on climate change for flood risk management defines two possible future scenarios of varying severity:

- Mid-range future scenario (MRFS)
- High-end future scenario (HEFS)

OPW's recommended allowances for both of these scenarios is shown in Figure 8.

	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	- 0.5 mm / year[1]
Urbanisation	*No General Allowance – Review on Case-by-Case Basis*	*No General Allowance – Review on Case-by-Case Basis*
Forestation	- 1/6 Tp^2	- 1/3 Tp^2 + 10% SPR^3

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduce the time to peak (Tp) by a third: This allows for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for increased runoff rates that may arise following felling of forestry.

Figure 8: OPW recommended allowances for future scenarios

Increase in the frequency of extreme events, particularly hydrological extremes, storms and droughts may cause an increase in rainfall intensity, duration and amount, resulting in increased surface water runoff and this should be accounted for by upscaling design flows by 20%.

In order to account for climate change and in the absence of Q100 + CC water levels from the Lee CFRAM Study we have assumed that the Q1000 design water levels along the Tramore equate to the Q100 + CC water levels. While this is an approximation it is considered appropriate in the context of the scope of this report.

4.3 Freeboard

It is generally accepted that a minimum freeboard of 300mm above predicted flood levels is appropriate for establishing minimum floor levels. Therefore, a 300mm freeboard is proposed for this development.

4.4 Recommended Flood Defence Level

Based on the above, the following flood defence level for the site is recommended:

5.94mOD (approximation to the 1 in 100-year design flood level + climate change allowance) + 0.3m freeboard = **6.24mOD**.

The finished floor level of any future development at the site therefore needs to be set at a minimum level of 6.24mOD. We note existing ground levels across most of the site are elevated above this level.

5 Management of Residual Flood Risk at the Subject Site

5.1 Finished Floor Level at the site

The FFL of the buildings on the site will range from **+7.50 to +12.00mOD**. There will also be an undercroft carpark with an FFL of **+8.00mOD.**

5.2 Access and Egress Routes to the Site

Given the absence of a significant risk of flooding of the site, access and egress routes are unlikely to be compromised during flood events.

5.3 Storage and Conveyance

The proposed development will have no impact on floodplain storage and conveyance as it is located outside of the 1 in 1000-year flood plain.

There will therefore be no off-site impact of any development on the site.

5.4 Site Drainage System

The site is currently almost entirely impermeable and understood to discharge at an unrestricted rate. Surface water discharge from the proposed development will be restricted in line with CCiC Drainage Divisions requirements. The proposal is to greatly reduce the pre-development discharge rates by restricting run-off from site to a QBAR Greenfield Runoff rate of 3.17 ls/ha. Surface water discharges in excess of the allowable Greenfield Runoff rate will be retained on site in the form of an underground attenuation tank for storms up to and including the 1 in 100-year event + 10% allowance for climate change.

In the event of a very extreme high-intensity rainfall event exceeding the surface water design criteria (1 in 100 year storm event + 10% allowance for climate

change), the capacity of the proposed drainage system on the site could be overwhelmed, leading to surface water/ ponding on the site. It will therefore be ensured that the floor levels of the proposed buildings are elevated above the surrounding ground levels and/or the surrounding ground levels will be profiled to promote flow of surface water away from the buildings in order to minimise the risk of surface water ingress in a design exceedance event.

The reader is referred to the accompanying site drainage report which is submitted as part of the planning application for further details.

6 Application of 'Flood Risk Management Guidelines'

6.1 Vulnerability Classification

The proposed development for the site is a mixture of residential and commercial developments and is therefore classed as a 'Vulnerable development' as per the vulnerability classification below.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).
*Uses not listed here should be considered on their own merits	

Figure 9: Vulnerability Classification - extract from "The Planning System and Flood Risk Management – Guidelines for Planning Authorities (Nov 09)" published by the OPW.

6.2 Flood Zones

The proposed development is not indicated as being within the 1000-year floodplain. In accordance with the OPW's planning guidelines, the site therefore lies within Flood Zone C.

6.3 Sequential Approach

The figure below illustrates the sequential approach to be adopted under the 'Planning System and Flood Risk Management' guidelines.

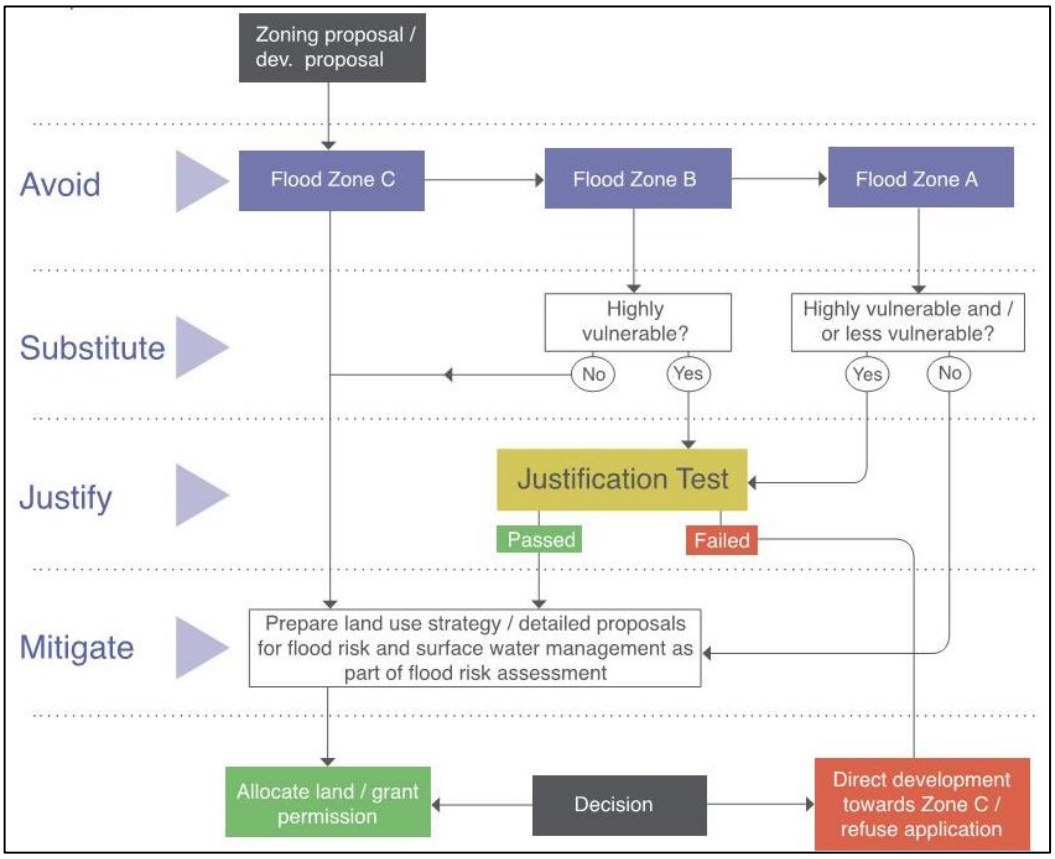

Figure 10: Sequential Approach

As the proposed development lies within Flood Zone C, a Justification Test is not required, and it is necessary only to identify mitigation measures for any residual risks.

7 Conclusion

The risk of fluvial flooding from the nearby Tramore River is considered to be low. The risk of pluvial flooding, tidal flooding and groundwater flooding is also considered to be low.

In the event of a very extreme high-intensity rainfall event, the capacity of the drainage system for the proposed development could be exceeded leading to surface water/ponding on the site. It will therefore be ensured that the floor levels of the proposed buildings are elevated above the surrounding ground levels and/or the surrounding ground levels will be profiled to promote flow of surface water away from the buildings in order to minimise the risk of surface water ingress in a design exceedance event. Surface water attenuation structures will be incorporated into the surface water drainage system to attenuate the excess runoff in line with CCiC requirements.

Floodplain storage and conveyance will not be impacted by the proposed development and there will be no increase of flood risk off site.

The site is located in Flood Zone C and so a Justification Test for the development is not required and it is necessary only to identify mitigation measures for any residual flood risk which has been described in this report.