Waterman Moylan
Engineering Consultants

Flood Risk Assessment

Proposed Residential Development at Brewery Road, Stillorgan.

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Comments

Disclaimer

Content

1. Introduction

This Flood Risk Assessment (FRA) has been prepared by Waterman Moylan as part of the documentation in support of a SHD planning application for a proposed residential development at Brewery Road, Stillorgan.

This FRA has been carried out in accordance with the Department of Housing and Local Government (DEHLG) and the Office of Public Works (OPW) document *"The Planning Process and Flood Risk Management Guidelines for Planning Authorities"* published in November 2009. This Assessment identifies and sets out possible mitigation measures against potential risks of flooding from various sources. Sources of possible flooding include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical error.

This report provides an assessment of the subject site for flood risk purposes only.

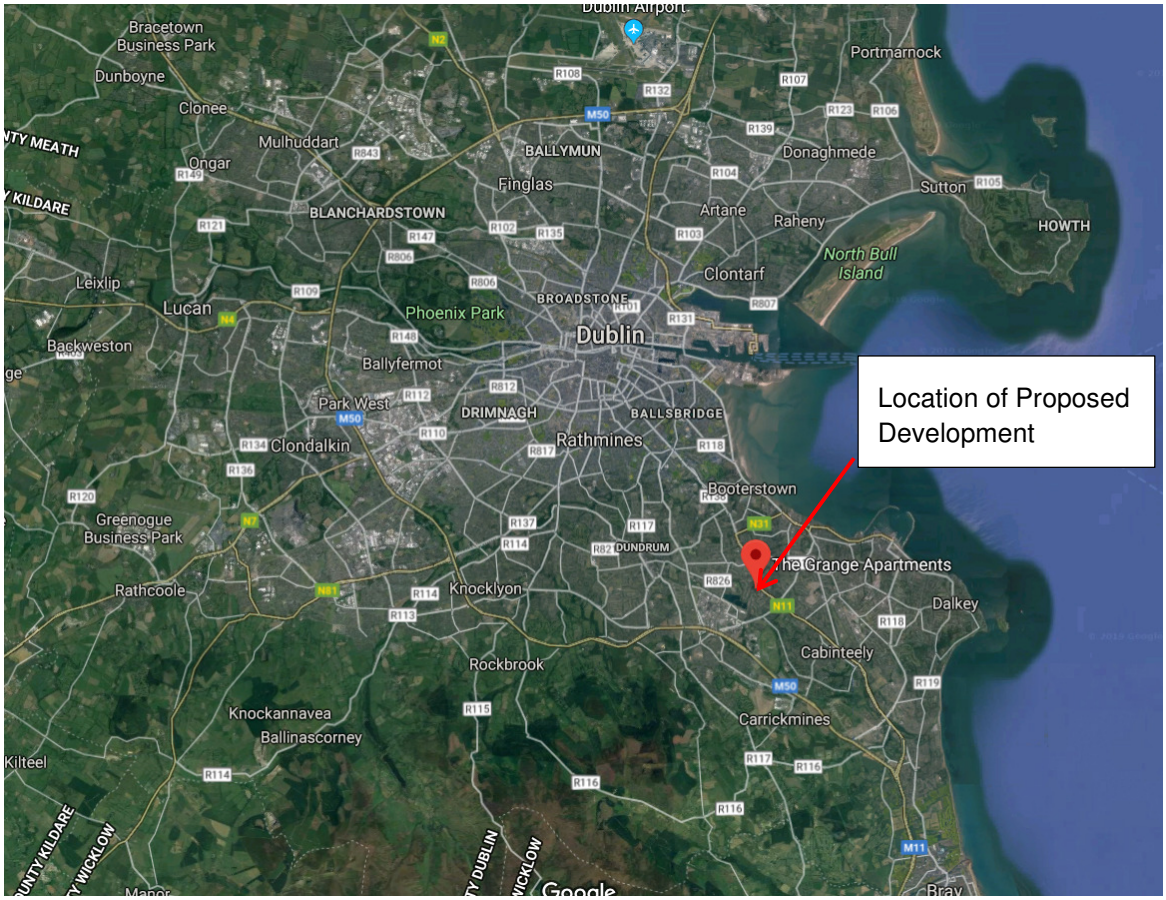
2. Site Description

2.1 Site Location

The site is in Stillorgan, Co.Dublin. It is bounded to the north by Brewery Road, to the east by Stillorgan Road, to the southwest by the Leopardstown Tennis Club and to the southeast by existing residential developments. The proposed development is approximately 2.5km from the coastline at Blackrock and 440m north of Mulchanstown Reservoir.

Refer to Figure 1 for the location of the proposed development.

Figure 1: Site Location (image taken from Google Earth)



2.2 Existing Development

The total site area is approximately 1.8 hectares and is currently 50% hardstanding. The Grange Marketing Suite, The Lodge (an existing 2-storey house), Oaktree Business Centre and the now redundant site set up for the neighbouring development currently occupy the site. There are also several well-established trees and foliage on site occupying an area of approximately 257m^2.

2.3 Proposed Development

It is proposed to construct 287 No. residential units with the associated tenant amenities over basement bike and carparking. The proposals also include the construction of a new Creche to accommodate 23 staff and 115 children on site. The developer will construct all associated infrastructure to service the development including a network of foul water and surface water drains, watermain and a realigned access road and footpaths.

The existing road levels around the site range from 66.01m – 74.00m OD. The ground floor of the proposed building steps across the site to mimic the existing levels on site as much as reasonably practicable. The lowest Ground Floor level is adjacent to Brewery Road and is at a level of 66.00m OD.

The site's main vehicular access will be provided from Brewery Road. The existing access onto Brewery Road will be modified to improve the junction layout and forward visibility. The majority of the carparking onsite will be accessed from a ramp off the main site access road. There is a total of 84 No. parking spaces at basement level and 16 at surface level for use by the Creche, Visitors and GoCar car club. There are 596 No. bicycle parking spaces provided. Pedestrian access will be provided along the building elevation facing onto Brewery Road and from the footway provided on both sides of the vehicular entrance road.

3. Flood Risk

3.1 Introduction

The components to be considered in the identification and assessment of flood risk are set out in Table A1 of the DEHLG/OPW guidelines on the Planning Process and Flood Risk Management and are summarised below:

- Tidal – flooding from high sea levels;
- Fluvial – flooding from water courses;
- Pluvial – flooding from rainfall / surface water;
- Ground Water – flooding from springs / raised ground water and
- Human/mechanical error – flooding due to human or mechanical error.

Each component will be investigated from a source, pathway and receptor perspective and the likelihood of flood occurring and the possible consequences will be assessed.

The likelihood of flooding falls into three categories; low, moderate and high, as described in the OPW Guidelines and set out in Table 2.

Table 1: OPW Guidelines

Likelihood	Low	Moderate	High
Tidal	Where probability < 0.1 % chance of occurring in a year	0.5 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 0.5 % chance of occurring in a year
Fluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year
Pluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year

For ground water and human/mechanical error, the limits of probability are not defined and therefore professional judgment is used. However, the likelihood of flooding is still categorised as low, moderate and high for these components. The likelihood and possible consequence of each event is considered, and the risk is evaluated. Risks will be mitigated where possible and the residual risks will then be considered as part of this assessment.

This report has considered the Eastern Catchment Flood Risk Assessment & Management (CFRAM) Study and maps prepared by RPS Group Ireland for the OPW. In addition, the Strategic Flood Risk Assessment (SFRA) prepared as part of the Dublin City Council development Plan 2016-2022 has been considered.

3.2 Tidal – Irish Sea

Tidal Flooding is caused by elevated sea levels or overtopping by wave action. The Irish Sea is approximately 2.5km east of the subject site. The Dublin Coastal Protection Project indicated that the 2002 high tide event reached 2.95m OD Malin. The subject site is, between 66.01m and 74.00m above the highest tide recorded in the Dublin Coastal area.

Given that the site is located 2.5km inland from the Irish Sea, the site levels exceed the highest ever recorded or projected tide in the area, and that there is no coastal flooding indicated on the OPW map, the risk from tidal flooding is considered extremely low and no flood mitigation measures need to be implemented.

3.3 Fluvial

The Carysfort Maretimo Fluvial Flood Extents study map (EO9CAR_EXFCD_F2_06 Sheet 6 of 7), dated 27 October 2017, as shown in Figure 2. indicates that a proportion of the site at the entrance and in the vicinity of Block N is at risk of flooding during the 1 in 1000 year storm event. It is noted that the flood map indicated a 1 in 1000 year food level of 63.28m OD. The corresponding road level in the same location of node SO20274210 is 66.11m OD, therefore the flood level indicated on the flood map cannot be considered accurate.

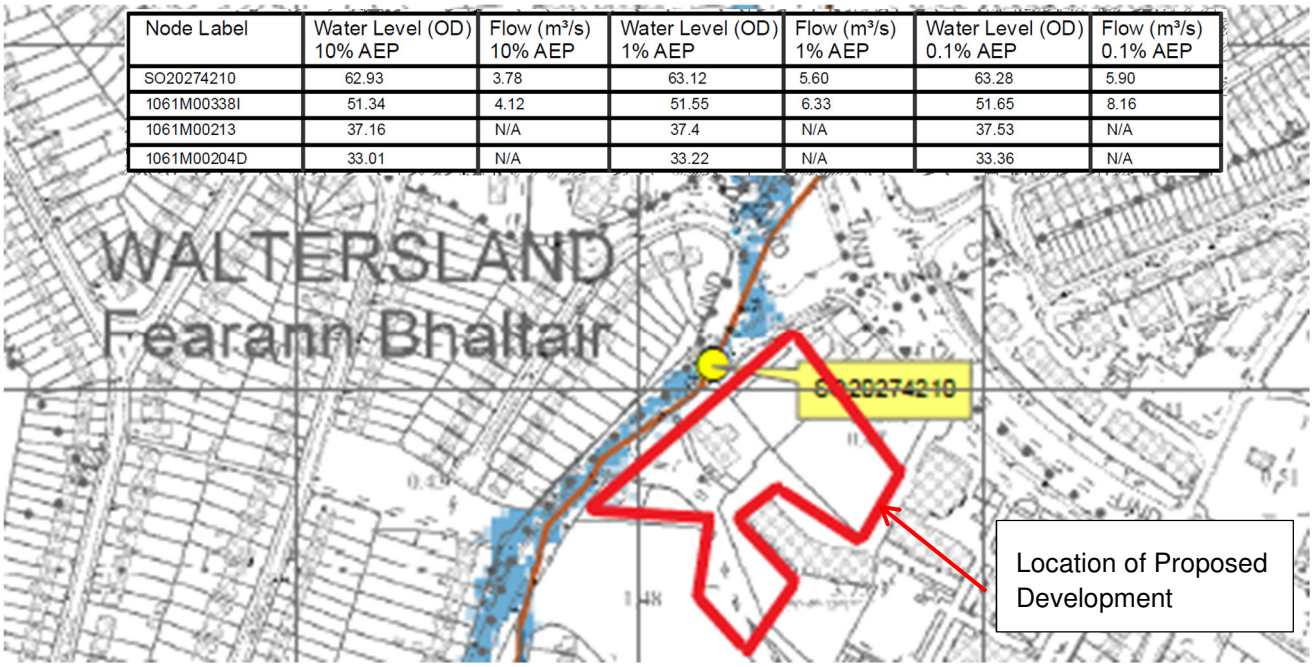
Furthermore, the primary area indicated as flooding is Brewery Road which falls steeply as it passes The Grange Development. The road level at the entrance to The Grange is 68.5m where as the road level at the N11 is 65.78m OD. The distance from The Grange entrance to the N11 is only 175m. We would note that the flooding shown on the flood map is most likely overland flow. This is also supported by the "Eastern CFRAM Study HA09 Hydraulics Report, Carysfort Maretimo Model, Final Draft F03 issued 05/08/16", which states that the "Low Depth flooding along Brewery Road is caused by surcharging manholes". The report then goes on to state that "the out of bank flow depths are generally below 100mm" and there is no mention of any ponding in close proximity to the site.

In order to ensure an adequate free board is achieved, in the absence of accurate flood levels, the existing levels on site were compared to the flood extents map. The existing vehicular entrance, which is at a level of 68.5m OD is indicated as being at risk of flooding during the 1 in 1000 year event. It is proposed that the finished floor level of Block N, adjacent to this entrance, will be 69.5m OD ensuring that an adequate free board is achieved.

In addition, safe access for emergency services can be maintained to the development during an extreme flood event via the Stillorgan Road from the south of the development. And safe access and egress for pedestrians can also be achieved by moving south from the building entrance towards the existing Grange development.

Figure 2: OPW Fluvial Flood Node Details

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
SO20274210	62.93	3.78	63.12	5.60	63.28	5.90
1061M00338I	51.34	4.12	51.55	6.33	51.65	8.16
1061M00213	37.16	N/A	37.4	N/A	37.53	N/A
1061M00204D	33.01	N/A	33.22	N/A	33.36	N/A



3.4 Pluvial

Pluvial flooding is from heavy rainfall and is often referred to as flooding from surface water. Surface water flooding can occur as a result of overland flow or ponding during periods of extreme prolonged rainfall. Flooding may occur through any of the pathways outlined in Table 3. and the risk associated with each pathway is outlined below.

Table 2: Pathways/Receptors

	Pathway	**Receptor**
1	Surcharging of the proposed internal drainage systems during heavy rainfall events leading to internal flooding	Proposed development – Basement and buildings
2	Surcharging from the existing surrounding drainage system leading to flooding within the subject site by surcharging surface water pipes	Proposed development – Basement and buildings
3	Surface water discharging from the subject site to the existing drainage network leading to downstream flooding	Downstream properties and roads
4	Overland flooding from surrounding areas flowing onto the subject site	Proposed development – Basement and buildings
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

3.4.1 On-site drainage system surcharging

The proposed on-site surface water drains have been designed to accommodate flows from a 5-year return event which indicates that the internal system may surcharge during rainfall events with a return period in excess of five years. Therefore, the likelihood surcharging of the on-site drainage system is considered high over the lifetime of the building. The risk of flooding is mitigated however by providing attenuation for the development which can store water for the 1 in 100-year storm event plus a 20% allowance for climate change and therefore the residual risk is low.

3.4.2 Flooding from the existing surrounding drainage system surcharging

The existing drainage system is a separate foul and surface water drainage systems and the existing site drains to the separate foul and surface water public sewers in Brewery Road. There have been no recorded sewer flooding events in the immediate vicinity of the site. The surface water drainage from the proposed development will be attenuated on site and will have a restricted outflow to the public surface water sewer, reducing the rate of run-off to the sewer and further reducing the risk of the sewer surcharging. Therefore, the likelihood of flooding due to surcharging the existing drainage network is considered low.

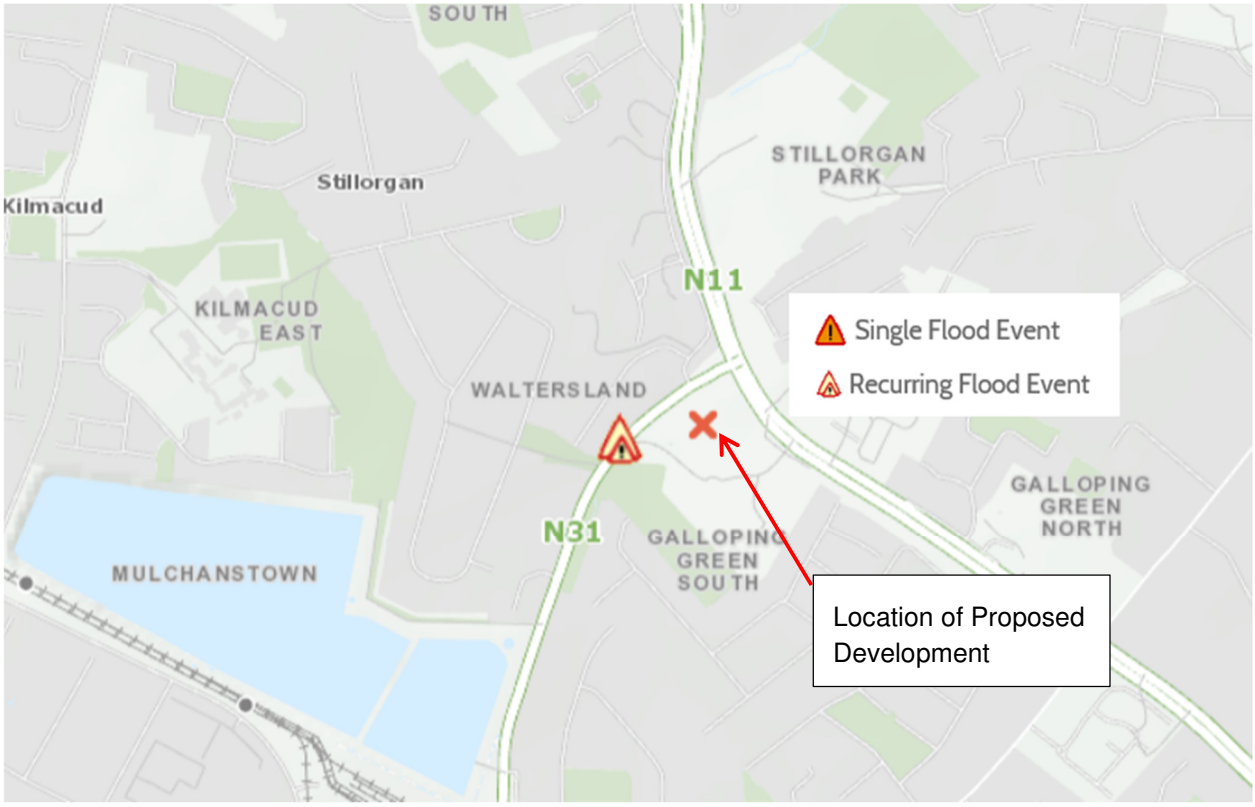
3.4.3 Surface water discharge from the subject site causing downstream flooding

The proposed development site is already 98% hard-surfaced. The development, as designed, will increase the permeable area due to the installation of permeable paving, planters, green roofs and podium areas and swales all of which will help reduce the volume of run-off from the site during low storm events. Surface water discharging from the development will be limited by hydrobreaks with a peak discharge of 6.36l/s for the development. This will reduce the effects of the development on the local existing drainage network further reducing the risk of downstream flooding. The likelihood of the proposed development resulting in pluvial flooding downstream of the site is therefore considered extremely low.

3.4.4 Overland flooding from surrounding areas

A map showing all flood events within close proximity of the subject site is provided below in Figure 3. There is 1 recurring instance of flooding on Brewery Road to the north of the site. Upon investigation, these events occurred in 1963 and there have been no recorded flood events since then and there have been extensive improvements to the drainage network since 1963. In addition, the development is at a higher level than Brewery Road, directing overland flows from any drainage system failure away from the development. It is therefore considered that there is a low likelihood of flooding from surrounding areas.

Figure 3: Past Flood Events



3.4.5 Overland flooding from the subject site

Positive drainage in the form of gullies and ACO drains as well as SUDS systems such as permeable paving and Swales will be provided to collect and discharge rain falling on hard standing areas to the attenuation tanks. External pavement will be laid so that water will be directed away from building entrances towards the drainage gullies and channels. Building maintenance will be responsible for ensuring the gullies and channels are kept free of debris and therefore, the risk to both the development and the surrounding areas from overland flooding from the development is considered low.

3.5 Groundwater

A site investigation (SI) has been carried out on site and although no groundwater was monitored on site during the borehole logs, standpipes were left in 3 of the boreholes (BH) for groundwater monitoring. Groundwater was subsequently found in all three boreholes at a level of 2.8, 2.6 and 1.25m below ground level which equates of 67.4mOD BH2, 66.97 mOD in BH7 and 66.43mOD in BH09. Therefore, adequate measures to waterproof the areas at risk, for example the basement carpark, must be put in place. In the event of ground water flooding the access road and surrounding green areas, this water can escape from the site via the overland flood routing as there is a rise in level from the access road to the basement entrance ramp and the building levels have been set higher than the surrounding access road levels. Therefore, there is low residual risk of flooding from ground water.

3.6 Human / Mechanical Errors

The subject land will be drained by an internal private storm water drainage system which discharges to the existing separate foul and surface water sewer network. This internal surface water network is a source of possible flooding from the system if it were to block. If the proposed private drainage system blocks this could lead to possible flooding on the podium levels and within the private areas, private access road and basement levels.

In order to mitigate against the risk of flooding from blockages the surface water network must be regularly maintained and where required cleaned out. The building management team will be expected to prepare and follow a maintenance schedule which ensures all drainage is checked and cleared at least annually and after a heavy storm event.

Swales, permeable paving and catch-pit gullies and manholes will be provided in order to minimise the volume of debris entering the drainage system and mitigate the risk of flooding.

Upon adoption of the proposed flood risk management strategies, outlined above, there is a low residual risk of overland flooding from human / mechanical error.

Should a partial or total blockage occur within the drainage system the surrounding ground levels have been set so that the resulting flood water is directed away from the building entrances. An overland flow path drawing has been included with the planning pack and indicates the route water will take should surcharging of the system occur at ground level. Should a blockage occur in the basement carpark system the flood water will be stored within the cycle parking area which is at a level of 66.40m OD before flowing out the cycle parking entrance door and onto Brewery road which is at a level of 66.13m OD and falling towards the east immediately outside of the cycle parking entrance. Any flood water in the basement will be instantly recognisable to the site management team which will allow for a fast response. The likelihood

of this occurring is extremely low considering the steps outlined above to prevent a blockage occurring therefore the residual risk is considered low.

4. Sequential Test

A sequential approach to planning is a key tool in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding. The sequential approach is set out in *"The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009"* and shown in Figure 4 below.

Figure 4: Sequential Approach (extract from Dublin City Council Development Plan 2016-2022 SFRA)

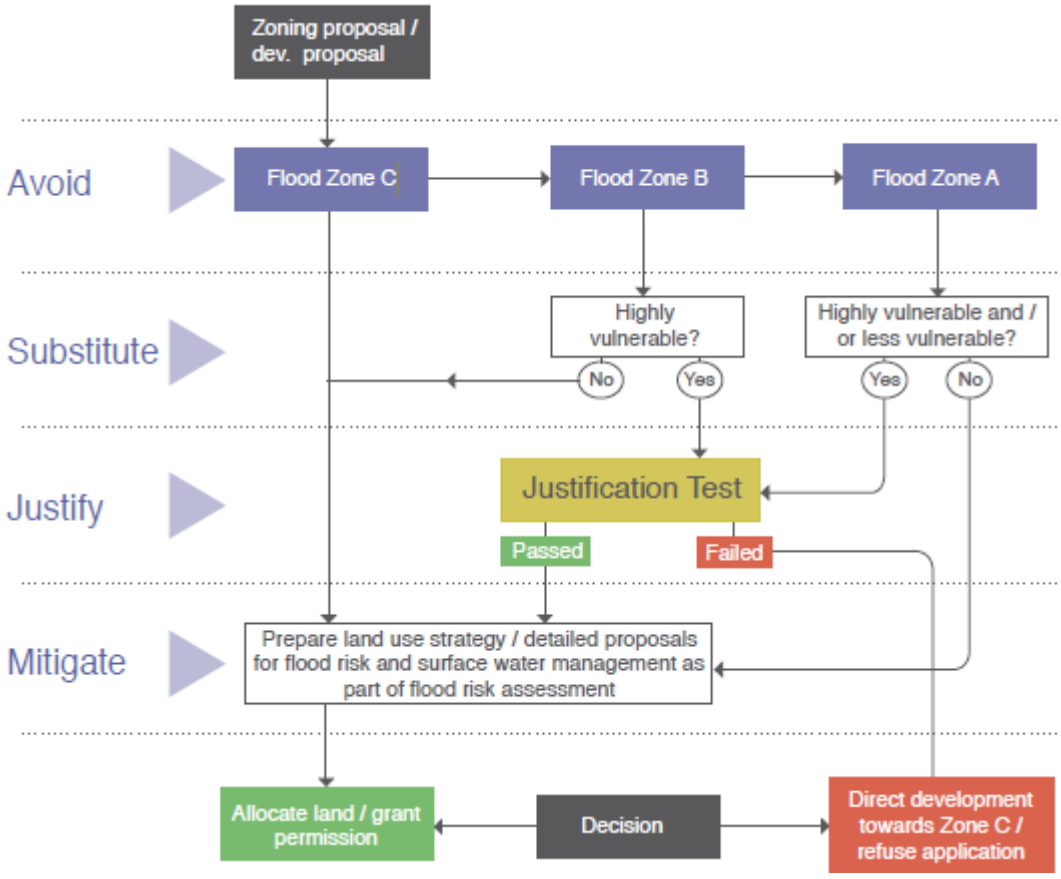


Table 3 below lists the vulnerability classes assigned to each land use and type of development and Table 4 outlines the matrix of vulnerability versus flood zone. Residential development is classified as "Highly vulnerable" development. As indicated in section 3.3, the Carysfort Maretimo Fluvial Flood Extents study map (EO9CAR_EXFCD_F2_06 Sheet 6 of 7), indicates that a proportion of the site at the vehicular entrance from Brewery Road and in the vicinity of Block N is located in Flood Zone B. "Highly Vulnerable" developments require justification tests to assess the appropriateness or otherwise of particular developments that are being considered in areas of moderate risk of flooding.

Table 3: Classification of Vulnerability of different types of development. (The Planning and Flood Risk Management Guidelines for Planning Authorities, 2009, OPW)

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	

Table 4: Matrix of vulnerability versus flood zone (The Planning and Flood Risk Management Guidelines for Planning Authorities, 2009, OPW)

	FLOOD ZONE A	FLOOD ZONE B	FLOOD ZONE C
Highly vulnerable development	JUSTIFICATION TEST	JUSTIFICATION TEST	APPROPRIATE
Less vulnerable development	JUSTIFICATION TEST	APPROPRIATE	APPROPRIATE
Water-compatible development	APPROPRIATE	APPROPRIATE	APPROPRIATE

4.1 Justification Test

The Dun Laoghaire Rathdown County Council, County Development Plan 2016-2022 contains a Strategic Flood Risk Assessment (SFRA) of Dun Laoghaire Rathdown. The flood risk, flood risk management and development management policies raised in the SFRA have been reviewed with respect to the proposed development.

A small section of the proposed residential development is within Flood Zone B: moderate Probability of flooding and is at risk of fluvial flooding as shown in *Figure 2 - The Carysfort Maretimo Fluvial Flood Extents study map (EO9CAR_EXFCD_F2_06 Sheet 6 of 7)*. Following guidelines set out in the SFRA the proposed development passes the justification test.

The proposed site is an existing developed area and is in Zoning Objective A, lands *"To protect and-or improve residential amenity"* as shown on Map 6 of the Development Plan. Therefore, the zoning and designation of the site demonstrates that the development complies with Part 1 and 2 of the Justification Test.

The proposal has been subject to an appropriate flood risk assessment which shows:

- The development will not increase the flood risk elsewhere.
- It is proposed that the finished floor level of Block N, adjacent to the entrance, will be 69.5m OD ensuring that an adequate free board above the 1 in 100-year fluvial flood event including climate change is achieved.
- Site levels are managed so that overland flows are not directed into the site and they remain within Brewery Road as existing.
- The entrance into Block N is located above the flood Zone and therefore there is an appropriate evacuation route through the existing Grange development onto the N11 Stillorgan Road.

5. Conclusions and Recommendations

The subject site has been analysed for risks from tidal flooding from the Irish Sea, fluvial flooding from the Carysfort Maretimo, pluvial flooding, groundwater and drainage system failures due to human error or mechanical system failure. Table 5 below presents the various residual flood risks involved. As the flood risk from all sources can be mitigated, reducing the flood risk to low or very low, the proposed development is considered acceptable in terms of flood risk.

Table 5: Summary of the Flood Risks from each flooding type.

Source	Pathway	Receptor	Likeli-hood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	Irish Sea Coastal zone	Proposed Development	Low	High. Flooding of building and the basements	Very Low	None required	**Very Low**
Fluvial	Carysfort Maretimo	Proposed Development	Low	Moderate. Water ingress into the building and basements	Very Low	None required	**Very Low**
Pluvial	Private and Public Drainage Network	Proposed Development	High	High. Flooding of the building and basements	High risk of damage to the building and basements	Appropriate drainage design, over land flood routing and setting of appropriate floor levels	**Low**
Ground Water	Groundwater present in the ground seeping through basement walls and floor	Proposed Development	High	Moderate. Ground water ingress into basement	Low	Adequately waterproofing of basement structure if found necessary	**Low**
Human / Mechanical Error	Drainage network	Proposed Development	High	Moderate. Water ingress into the building and basements	Moderate risk of damage to the building	Maintenance strategy	**Low**

UK and Ireland Office Locations