Flood Risk Assessment

Proposed Residential Development at Grange Road, Dublin 13

December 2023

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This document has been prepared and checked in accordance with
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Comments

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1. Introduction

1.1 Context

This Flood Risk Assessment has been prepared by Waterman Moylan on behalf of Rondesere Ltd. as part of the documentation in support of a planning application for a proposed residential development located off Grange Road in Dublin 13.

This Flood Risk Assessment has been carried out in accordance with the *DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management* published in November 2009. This assessment identifies the risk of flooding at the site from various sources and sets out possible mitigation measures against the potential risks of flooding. Sources of possible flooding include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical errors. This report provides an assessment of the subject site for flood risk purposes only.

1.2 Site Location and Description

Rondesere Limited intends to apply for a Planning Permission for a Large-Scale Residential Development (LRD) on a site at Grange Road, Baldoyle, Dublin 13.

The site is bounded to the north by Myrtle Road and existing residential development, by Grange Road to the south separating the subject site with Baldoyle Industrial Estate, by Longfield Road and Beshoff Motors Car Dealers to the east and an educational facility currently under construction on lands adjoining the west of the subject site. The site is located approximately 900m north of the Howth Junction Dart Station and 500m south of Clongriffin Station. Vehicular access is proposed from the northern boundary of the site via a new access off Myrtle Road. The site location is indicated on the Figure below:

Figure 1 | *Site Location (Source: Google Maps)*

The site is approximately 0.4 Hectares and is currently in use by the Applicant as a storage area. Topographic survey data indicates that the site falls generally from west to east, with a high point of approximately 8.9m OD Malin at the south-west of the site and a low point of approximately 7.8m OD Malin at the north-east of the site.

In the Fingal County Development Plan 2023-2029, the subject site is zoned as a Residential Area, defined as an area to "provide for residential development and protect and improve residential amenity", as shown in the extract below:

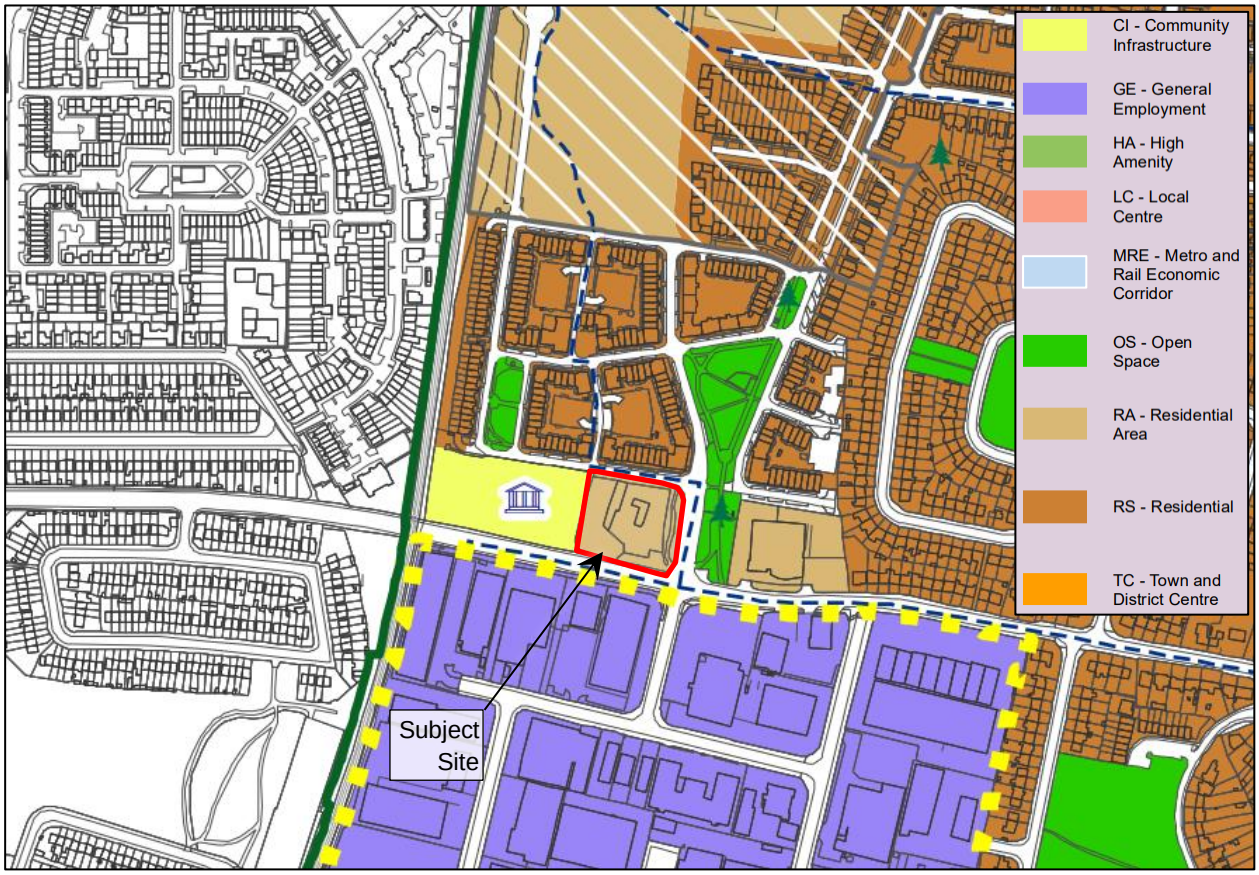

***Figure 2** | Extract of Fingal Development Plan Zoning Map Sheet 10*

1.3 Proposed Development

The proposed Large-scale Residential Development consists of the following;

1. Demolition of existing, single storey, storage structures on the subject site (c. 446.5 m^2 GFA).

2. The construction of a residential development (c. 15, 234.11 m^2 GFA) comprising of 120 no. apartment units (15 no. studio units, 18 no. 1 bed units, 78 no. 2 bed units, 7 no. 3 bed units, 2 no. 4 bed penthouse units) within 1 no. block (ranging in height from 4 - 12 storeys over basement level).

3. The construction of a basement to be accessed off Myrtle Road with provision of c. 47 no. car parking spaces, including accessible spaces, electric vehicle charging points and residential visitor parking.

4. Addition of 2 no. crèche drop off car parking spaces at surface level.

5. Provision of 360 no. 'long stay' residential bicycle parking spaces at basement level together with additional 60 no. visitor bicycle parking spaces in secure locations at surface level.

6. All apartments are provided with private terraces / balconies.

7. Provision of c. 1877 m^2 of open space to serve the development including green roof garden terraces between 5th and 10th floor level.

8. Provision of a childcare facility at ground floor level (c. 156.6 m^2 GFA) with capacity in the order of 35 no. children and associated, secure, open play area (c. 117.1 m^2).

9. Provision of Café unit (c. 70 m^2 GFA) at ground floor level with associated outdoor seating area.

10. Provision of associated gymnasium at ground and first floor level (c. 273.12 m^2).

11. Provision of Multipurpose Room (c. 48 m^2 GFA) and Residents Lounge (c. 20 m^2) at first floor level.

12. Total non-residential use is c. 567.72 m^2 (3.73 % of overall development).

13. The development will also provide for all associated ancillary site development infrastructure including: ESB sub-station, bike stores, bin stores, plant rooms, public lighting, new watermain connection and foul and surface water drainage; internal roads & footpaths; site landscaping, including boundary treatments; associated scheme signage, and all associated site development and excavation works above and below ground necessary to facilitate the development.

1.4 Guidelines and Resources

The Department of Environment, Heritage and Local Government (DEHLG) and the Office of Public Works (OPW) published the adopted version of the document "The Planning System and Flood Risk Management Guidelines for Planning Authorities" in November 2009.

These Guidelines provide guidance on flood risk and development. A precautionary approach is recommended when considering flood risk management in the planning system. The core principle of the guidelines is to adopt a risk-based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for river and coastal flooding.

This approach is based on the identification of flood zones for river and coastal flooding. "Flood Zones" are geographical areas used to identify areas at various levels of flood risk. There are three flood zones defined:

- Flood Zone A: (high probability of flooding) is for lands where the probability of flooding is greatest (greater than 1% or 1-in-100 for river flooding and 0.5% or 1-in-200 for coastal flooding).
- Flood Zone B: (moderate probability of flooding) refers to lands where the probability of flooding is moderate (between 0.1% or 1-in-1,000 and 1% or 1-in-100 for river flooding and between 0.1% or 1-in-1,000 and 0.5% or 1-in-200 for coastal flooding).
- Flood Zone C: (low probability of flooding) refers to lands where the probability of flooding is low (less than 0.1% or 1-in-1,000 for both river and coastal flooding).

Once a flood zone has been identified, the guidelines set out the different types of development appropriate to each zone. Exceptions to the restriction of development due to potential flood risks are provided for through the use of the Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated. This recognises that there will be a need for future development in existing towns and urban centres that lie within flood risk zones, and that the avoidance of all future development in these areas would be unsustainable.

Planning Authorities are required to introduce flood risk assessment as an integral and leading element of their development planning functions. A Strategic Flood Risk Assessment was prepared as part of the

Fingal Development Plan 2017-2023, which was informed by the DEHLG/OPW 2009 Guidelines for Planning Authorities.

The following guidelines and resources were referred to in preparing this flood risk assessment:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009 (DEHLG/OPW)
- Strategic Flood Risk Assessment for the Fingal Development Plan 2017-2023
- Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS)
- The OPW's National Flood Hazard Map
- Geological Survey Ireland (GSI) datasets

1.5 Assessment Methodology

This Flood Risk Assessment report follows the guidelines set out in the Guidelines on the Planning Process and Flood Risk Management. The components to be considered in the identification and assessment of flood risk are as per Table A1 of the above guidelines:

- Tidal – flooding from high sea levels
- Fluvial – flooding from water courses
- Pluvial – flooding from rainfall / surface water
- Groundwater – flooding from springs / raised groundwater
- Human/mechanical error – flooding due to human or mechanical error

Each component will be investigated from a Source, Pathway and Receptor perspective, followed by an assessment of the likelihood of a flood occurring and the possible consequences.

1.5.1 Assessing Likelihood

The likelihood of flooding falls into three categories of low, moderate, and high, which are described in the OPW Guidelines as follows:

Flood Risk Components	**Likelihood: % chance of occurring in a year**		
	Low	***Moderate***	***High***
Tidal	*Probability < 0.1%*	*0.5% > Probability > 0.1%*	*Probability > 0.5%*
Fluvial	*Probability < 0.1%*	*1% > Probability > 0.1%*	*Probability > 1%*
Pluvial	*Probability < 0.1%*	*1% > Probability > 0.1%*	*Probability > 1%*

Table 1 | *From Table A1 of "DEHLG/OPW Guidelines on the Planning Process and Flood Management"*

For groundwater and human/mechanical error, the limits of probability are not defined and therefore professional judgment is used. However, the likelihood of flooding is still categorized as low, moderate, and high for these components.

From consideration of the likelihoods and the possible consequences a risk is evaluated. Should such a risk exist, mitigation measures will be explored, and the residual risks assessed.

1.5.2 Assessing Consequence

There is not a defined method used to quantify a value for the consequences of a flooding event. Therefore, to determine a value for the consequences of a flooding event, the elements likely to be adversely affected

by such flooding will be assessed, with the likely damage being stated, and professional judgement will be used to determine a value for consequences. Consequences will also be categorized as low, moderate, and high.

1.5.3 Assessing Risk

Based on the determined 'likelihood' and 'consequences' values of a flood event, the following 3x3 Risk Matrix will then be referenced to determine the overall risk of a flood event.

		Consequences		
		Low	***Moderate***	***High***
Likelihood	**Low**	*Extremely Low Risk*	*Low Risk*	*Moderate Risk*
	Moderate	*Low Risk*	*Moderate Risk*	*High Risk*
	High	*Moderate Risk*	*High Risk*	*Extremely High Risk*

Table 2 | *3x3 Risk Matrix*

2. Sequential Test

2.1 General

A sequential approach to planning is a key tool in ensuring that a development, particularly any 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 is referred to in the Strategic Flood Risk Assessment for the Fingal Development Plan 2017-2023.

The sequential approach is illustrated in the Figure below:

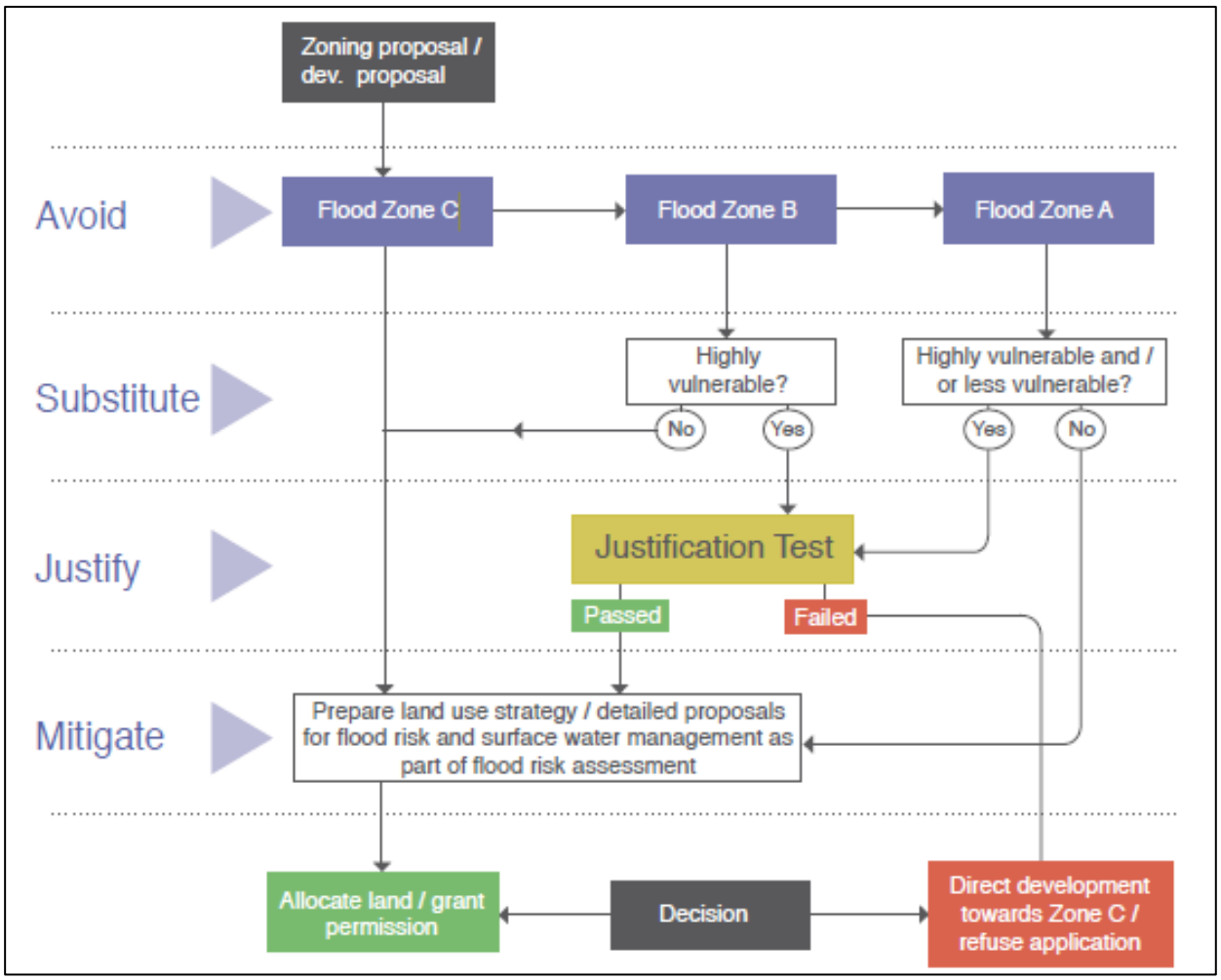

Figure 3 | *Sequential Approach*

2.2 Establish Flood Zone

The first step of the sequential test is to establish the flood zone within which the site lies.

The subject site is in Flood Zone C, as it is outside the 1-in-1,000-year flood zone for both tidal and fluvial flooding – refer to Sections 3 and 4, below, for further information on tidal and fluvial flooding, respectively.

2.3 Establish Vulnerability Class

The next step is to establish the vulnerability class of the proposal. The Table below, taken from the OPW's "Planning and Flood Risk Management Guidelines for Planning Authorities, 2009" document, lists the vulnerability classes assigned to various land uses and types of development:

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 campong, 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 3** | *Vulnerability Classification of Different Types of Development*

The proposed development is a residential development, and is therefore considered highly vulnerable development.

2.4 Assess Justification Test Requirement

The Table below outlines the matrix of vulnerability based on the Flood Zone:

Description	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 4 | *Vulnerability Matrix*

Given that the subject site is within Flood Zone C, no justification test is required for the development, and development is considered appropriate.

3. Tidal Flooding

3.1 Source

Tidal flooding occurs when normally dry, low-lying land is flooded by seawater. The extent of tidal flooding is a function of the elevation inland flood waters penetrate, which is controlled by the topography of the coastal land exposed to flooding.

3.2 Pathway

The site is approximately 1.2km south-west of the nearest coastline at Baldoyle Estuary. The Dublin Coastal Protection Project indicated that the 2002 high tide event reached 2.95m OD Malin. The subject site has a low point of approximately 7.8m OD Malin, 4.85m above the historic high tide event.

The proposed raised table pedestrian crossing access at the basement entrance of the development has an elevation of 8.60m OD Malin (bottom of the ramp) and 8.65m OD Malin (top of the ramp), a minimum of 5.65m above the historic high tide event.

Coastal Flood Extent Maps, developed as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study, have been consulted as part of this assessment. These maps outline existing and potential flood hazard and risk areas which are being incorporated into a Flood Risk Management Plan. An extract of the nearest CFRAM Coastal Flood Extents Map is shown in the Figure below:

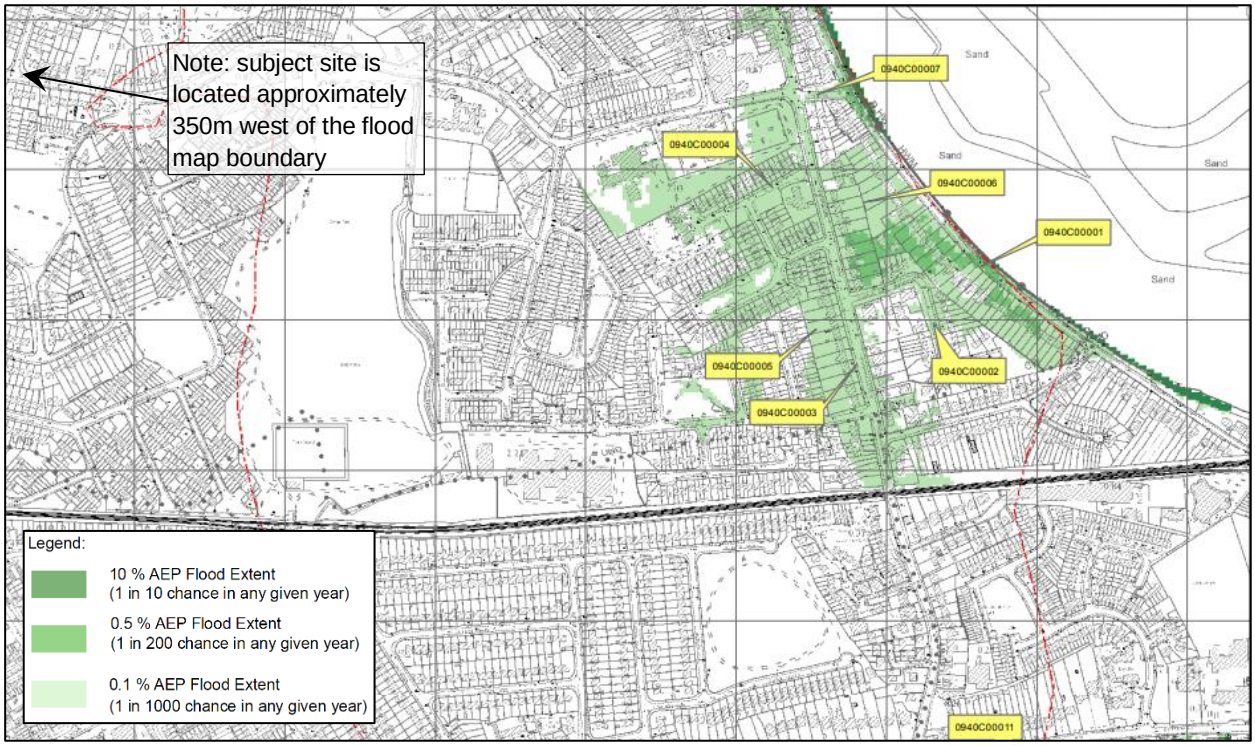

***Figure 4** | Extract of CFRAM Coastal Flood Extents Map*

High probability flood events, as shown in the above map, are defined as having approximately a 1-in-10 chance of occurring or being exceeded in any given year (10% Annual Exceedance Probability), medium probability flood events are defined as having an AEP of 0.5% (1-in-200-year storm), while low probability events are defined having an AEP of 0.1% (1-in-1,000-year storm). The map indicates that the subject development is not at risk of flooding for the 1-in-1,000-year event.

Given that the site is located 1.2km inland from the Baldoyle Estuary, that there is at least a 4.85m level difference between the subject lands and the high tide and given that the site is outside of the 1-in-1,000-year tidal flood plain, it is evident that a pathway does not exist between the source and the receptor. A risk from tidal flooding is therefore extremely low and no flood mitigation measures need to be implemented.

4. Fluvial Flooding

4.1 Source

Fluvial flooding occurs when a river's flow exceeds its capacity, typically following excessive rainfall, though it can also result from other causes such as heavy snow melt and ice jams.

4.2 Pathway

The Mayne River flows approximately 1.0km north of the subject site, discharging to the Baldoyle Estuary. Fluvial flood extent maps, developed as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study and made available on the OPW's National Flood Information Portal, have been consulted as part of this assessment. These maps outline existing and potential flood hazard and risk areas which are being incorporated into a Flood Risk Management Plan. An extract of the relevant map is shown in the Figure below:

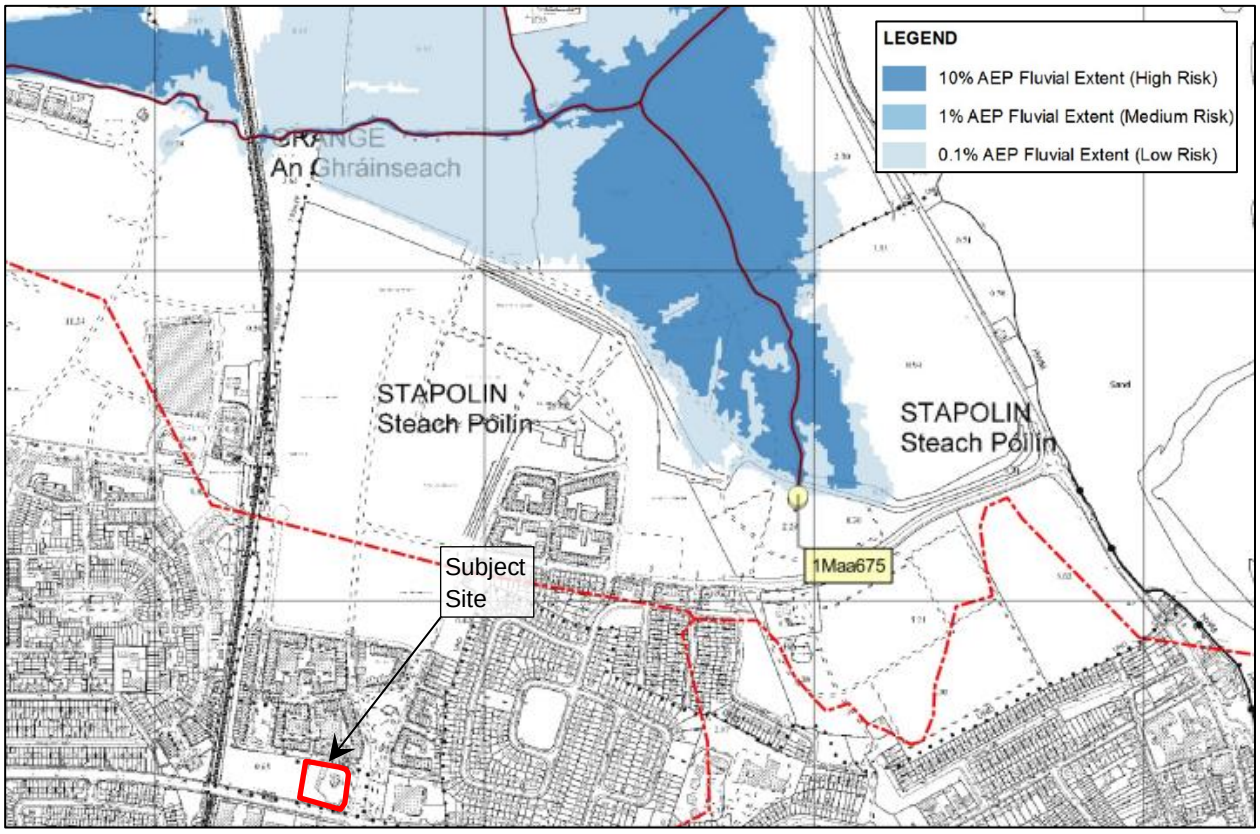

***Figure 5** | Extract of CFRAM Fluvial Flood Extents Map*

High probability flood events, as shown in the above map, are defined as having approximately a 1-in-10 chance of occurring or being exceeded in any given year (10% Annual Exceedance Probability), medium probability flood events are defined as having an AEP of 1% (1-in-100-year storm), while low probability events are defined having an AEP of 0.1% (1-in-1,000-year storm). The map indicates that the subject site is outside of the 0.1% AEP (1-in-1,000-year) flood plain.

The flood map also includes nodes with flood levels. The 0.1% AEP flood level at the nearest node is 3.46m OD Malin. The subject site has a low point of approximately 7.8m OD Malin, 4.34m above the 1-in-1,000-year fluvial flood level.

As mentioned, the proposed raised table pedestrian crossing access at the basement entrance of the development has an elevation of 8.60m OD Malin (bottom of the ramp) and 8.65m OD Malin (top of the ramp), 5.14m above the 1-in-10000-year fluvial flood level.

Given that the site is located 1km from the Mayne River, is outside of the 1-in-1,000-year flood plain, and is above the 1,000-year flood level, it is evident that a pathway does not exist between the source and the receptor. A risk from fluvial flooding is therefore extremely low and no flood mitigation measures need to be considered.

5. Pluvial Flooding

5.1 Source

Pluvial flooding occurs when heavy rainfall creates a flood event independent of an overflowing water body. Pluvial flooding can happen in any urban area, including higher elevation areas that lie above coastal and river floodplains.

5.2 Pathway & Receptors

During periods of extreme prolonged rainfall, pluvial flooding may occur through the following pathways:

	Pathway	Receptor
1	Surcharging of the proposed internal drainage systems during heavy rain events leading to internal flooding	Proposed development – properties and roads
2	Surcharging from the existing surrounding drainage system leading to flooding within the subject site by surcharging surface water pipes	Proposed development – properties and roads
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, properties and roads
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

Table 5 | *Pathways and Receptors*

5.3 Likelihood

The likelihood of each of the 5 pathway types are addressed individually as follows:

5.3.1 Surcharging of the proposed on-site drainage systems:

The proposed on-site surface water drainage sewers have been designed to accommodate flows from a 5-year return event, which indicates that on average 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.

5.3.2 Surcharging from the existing surrounding drainage system:

The OPW's National Flood Hazard Maps, extracted below, have been consulted to identify recorded instances of flooding in the vicinity of the site.

The nearest recorded flood event is indicated in close proximity to the subject site. This icon refers to flooding throughout Dún Laoghaire–Rathdown, Fingal and South Dublin, which occurred in November 1982. The accompanying report, prepared in January 1983, states that flooding occurred along Grange Road as the result of choking of a local culvert. The report notes that a screen had been obtained to prevent future choking of the culvert, and no further flooding is recorded as having occurred since 1982.

There are several other flood events recorded on the map, all of which are at least 700m from the site.

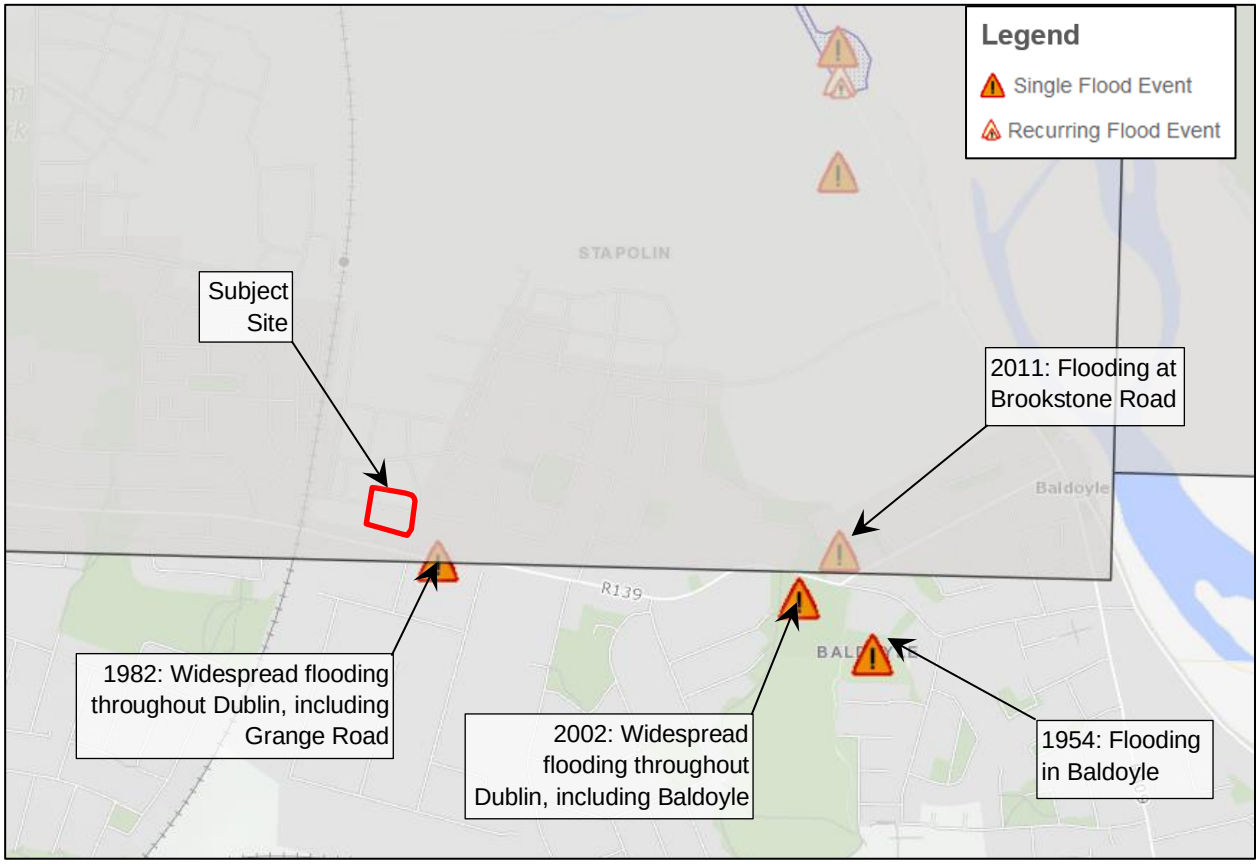

***Figure 6** | Extract from the OPW's Past Flood Events Map*

With no history of flooding in the area due to surcharging impacting the subject site, the likelihood of such flooding occurring is considered low.

5.3.3 Surface water discharge from the subject site:

The subject site is currently in use as a storage yard and is largely hardstanding. Introduction of SuDS features, as described in the accompanying Engineering Assessment Report, will reduce the likelihood of surface water discharge from the site leading to downstream flooding. As such, the likelihood can be considered low.

5.3.4 Overland flooding from surrounding areas:

Overland flooding from the surrounding area, in particular, Myrtle Road located directly north of the development and off which the basement is accessed could be a potential concern for flooding of the basement area. A raised table pedestrian crossing has been designed at the basement entrance with a high point of 8.65 m, 190 mm above the adjacent road level (8.46 m). The raised table will act as a barrier for overland flooding into the basement from the surrounding area.

Additionally, with no recorded flood events in the immediate area that could have an impact on the subject site, as per the OPW records referred to above, it is considered that there is a low likelihood of flooding from surrounding areas.

5.3.5 Overland flooding from the subject site:

The likelihood of overland flooding from the site is reduced, given that the existing site is almost entirely hardstanding, and the proposed development includes the introduction of SuDS features. As such, the likelihood can be considered low.

5.4 Consequence

Surface water flooding would result in damage to roads and landscaped areas and could impact the basement and ground floor level of the building. The consequences of pluvial flooding are considered moderate.

5.5 Risk

The risk of each of the 5 pathway types is addressed individually as follows:

5.5.1 Surcharging of the proposed on-site drainage systems:

With a high likelihood and moderate consequence of flooding the site from surcharging the on-site drainage system, the resultant risk is high.

5.5.2 Surcharging from the existing surrounding drainage system:

With a low likelihood and moderate consequence of flooding the site from the existing surface water network, the resultant risk is low.

5.5.3 Surface water discharge from the subject site:

With a low likelihood and moderate consequence of surface water discharge from the subject site, the resultant risk is low.

5.5.4 Overland flooding from surrounding areas:

With a low likelihood and moderate consequence of overland flooding from the surrounding areas, the resultant risk is low.

5.5.5 Overland flooding from the subject site:

With a low likelihood and moderate consequence of overland flooding from the subject site, the resultant risk is low.

5.6 Flood Risk Management

The following are flood risk management strategies proposed to minimise the risk of pluvial flooding for each risk:

5.6.1 Surcharging of the proposed on-site drainage systems:

The risk of flooding is minimised with adequate sizing of the on-site surface water network and SuDS devices. The substrate and the plant layers in the proposed green roofing will help to reduce runoff and will detain and slow peak flows. Similarly, trees and planted areas act as soft scape and will provide infiltration, significantly slowing down and reducing the amount of surface water runoff from the site. Permeable paving

will provide some treatment volume, with perforated filter drains encouraging infiltration before reaching the storm water sewer network.

These proposed source and site control devices will intercept and slow down the rate of runoff from the site to the on-site drainage system, reducing the risk of surcharging.

Furthermore, a hydro-brake or similar approved flow control device will provide a runoff limited to the greenfield equivalent runoff rate, with excess storm water to be attenuated on site. The attenuation has been designed with sufficient volume for the 1-in-100-year storm (accounting for a 20% increase due to climate change), to limit the runoff from the site and minimise the discharge rate into receiving waters (refer to Section 3 of the accompanying Engineering Assessment Report for further information on the proposed attenuation system).

As a result of these proposed measures, the likelihood of surcharging of the proposed on-site drainage systems is low.

5.6.2 Surcharging from the existing surrounding drainage system:

The risk of flooding due to surcharging of the existing surface water network is minimised with overland flood routing towards the open space and detention basin and away from the building – refer to the accompanying Overland Flood Route drawing no.GRR-WMC-ZZZ-00-DR-C-210.

The risk to the building is mitigated by setting finished floor levels at least 200mm above the adjacent road channel line.

5.6.3 Surface water discharge from the subject site:

Surface water discharge from the subject site is intercepted and slowed down through the use of source control devices, as described in Section 5.6.1 above, minimising the risk of pluvial flooding from the subject site. Surface water discharge from the site is restricted by a flow control device to the greenfield equivalent rate, with sufficient attenuation storage provided for the 1-in-100-year storm, accounting for a 20% increase due to climate change. As such, the rate at which surface water discharges from the subject site will not be increased as a result of the proposed development.

5.6.4 Overland flooding from surrounding areas:

The risk from overland flooding from surrounding areas is low. Overland flood routing and raised finished floor levels will provide protection for the proposed building, as described in Section 5.6.2 above.

5.6.5 Overland flooding from the subject site:

The risk of overland flooding from the subject site is minimised by providing SuDS features to intercept and slow down the rate of runoff from the site to the existing surface water sewer system, as described in Section 5.6.1 above. Sufficient attenuation is provided for the 1-in-100-year storm, accounting for a 20% increase due to climate change. Thus, even under extreme storm conditions, the surface water can be attenuated without causing flooding downstream.

5.7 Residual Risk

As a result of the design measures detailed above in Section 5.6, there is a low residual risk of flooding from each of the surface water risks.

6. Groundwater

6.1 Source

Groundwater flooding occurs when the water table rises above the ground surface. This typically happens during periods with prolonged rainfall which exceeds the natural underground drainage system's capacity.

6.2 Pathway

The pathway for groundwater flooding is from the ground. Note that although groundwater flooding is typically considered to be when the water table rises above the ground surface, underground services and building foundations could also be affected by high water tables that do not reach the ground surface.

6.3 Receptor

The receptors for ground water flooding would be underground services and the basement and ground floor of the building.

6.4 Likelihood

Geological Survey Ireland (GSI) produces a wide range of datasets, including groundwater vulnerability mapping. From the GSI groundwater vulnerability map, extracted below, the site lies within an area with low groundwater vulnerability.

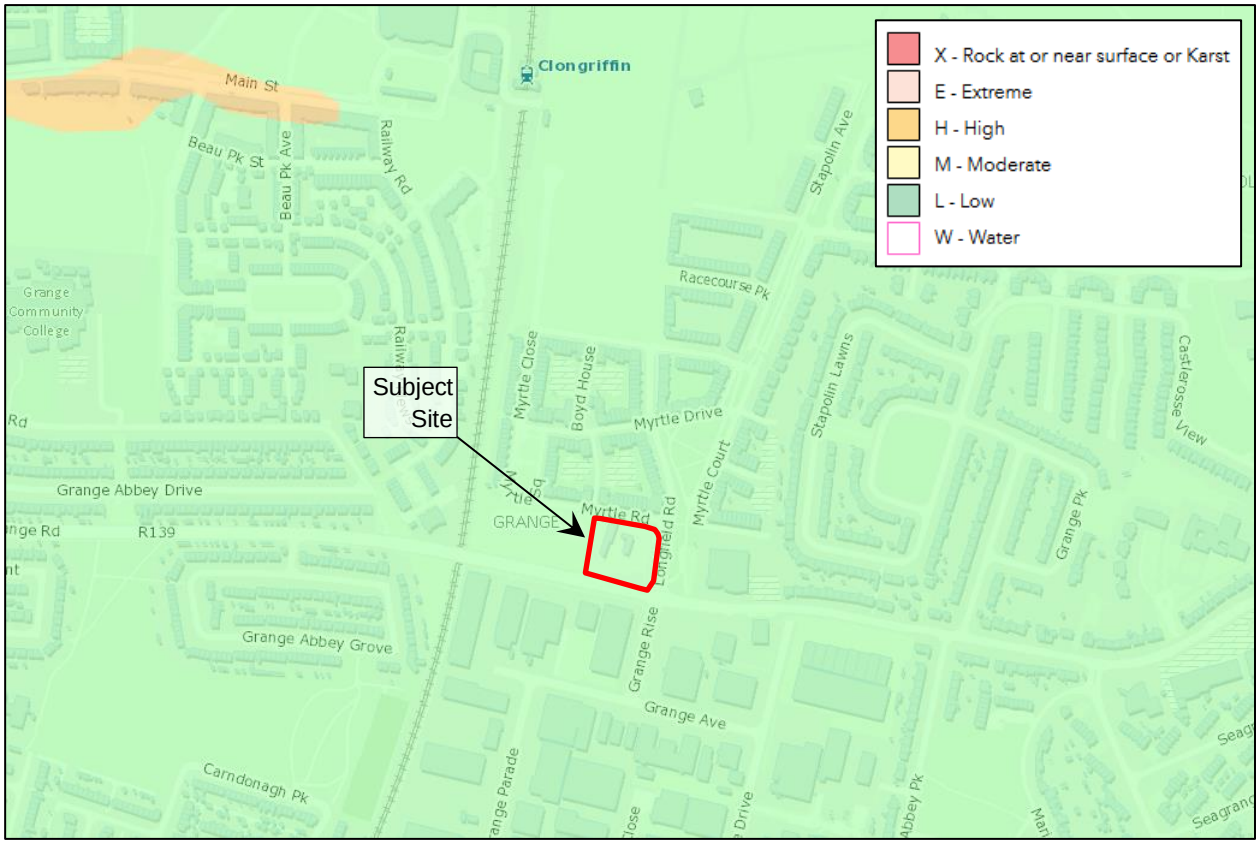

Figure 7 | *Extract of Groundwater Vulnerability Map*

With the site falling within an area with low groundwater vulnerability, the likelihood of groundwater rising through the ground and causing potential flooding on site during prolonged wet periods is low.

6.5 Consequence

The consequence of ground water flooding would be some minor temporary seepage of ground water through the ground around the proposed building. Underground services could be inundated from high water tables. Over time, groundwater could seep into the basement. Therefore, the consequence of ground water flooding occurring at the proposed development is considered moderate.

6.6 Risk

With a low likelihood and moderate consequences of flooding due to groundwater, the risk is considered low.

6.7 Flood Risk Management

The finished floor level has been set above the road level, as described in Section 5.6. This will ensure that any ground water in the vicinity of the building does not flood into the building.

The buildings' design will incorporate suitable damp-proof membranes to protect against damp and water ingress from below ground level. To mitigate the risks of groundwater entering the basement, it must be adequately waterproofed. Any penetrations through the slab or basement walls must also be appropriately sealed to prevent ingress of groundwater.

It is proposed to install a granular blanket surrounding the basement structure, which will allow groundwater to seep around the basement, maintaining any long-term sub-surface perched water movement. This will minimise the effect that the proposed basement will have on the local water table, mitigating the risk to surrounding areas including other basements in the vicinity of the site.

In the event of ground water flooding on site, this water can escape from the site via the overland flood routing, as described in Section 5.6.

6.8 Residual Risk

There is a low residual risk of flooding from ground water.

7. Human/Mechanical Errors

7.1 Source

The subject site will be drained by an internal private storm water drainage system out-falling to the existing drainage network. The internal surface water network is a source of possible flooding were it to become blocked.

7.2 Pathway

If the public drainage network in the vicinity of the site or if the proposed internal drainage system were to block this could lead to possible flooding within the private areas.

7.3 Receptor

The receptors for flooding due to human/mechanical error would be the basement and ground floor of the building, with possible flooding at neighbouring buildings.

7.4 Likelihood

There is a high likelihood of flooding on the subject site if the surface water network were to become blocked.

7.5 Consequence

The surface water network would surcharge and overflow through gullies and manhole lids. It is, therefore, considered that the consequences of such flooding are moderate.

7.6 Risk

With a high likelihood and moderate consequence, there is a high risk of surface water flooding should the surface water network block.

7.7 Flood Risk Management

As described in Section 5.6, the finished floor level has been designed to be above the adjacent road network which will reduce the risk of flooding if the public surface water network were to block. In the event of the surface water system surcharging, much of the surface water can still escape from the site by overland flood routing, as described in Section 5.6, without causing damage to the proposed building.

The surface water network (drains, gullies, manholes, AJs, attenuation system) will need to be regularly maintained and where required cleaned out. A suitable maintenance regime of inspection and cleaning should be incorporated into the safety file/maintenance manual for the development.

7.8 Residual Risk

As a result of the flood risk management outlined above, there is a low residual risk of overland flooding from human / mechanical error.

8. Conclusions and Recommendations

The subject lands have been analysed for risks from tidal flooding from the Baldoyle Estuary, fluvial flooding from the Mayne River, pluvial flooding, ground water and failures of mechanical systems. The table below presents the various residual flood risks involved:

Source	Pathway	Receptor	Likelihood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	*Baldoyle Estuary*	*Proposed development*	*Extremely low*	*None*	*Negligible*	*None*	Extremely low
Fluvial	*Mayne River*	*Proposed development*	*Extremely low*	*None*	*Negligible*	*None*	Extremely low
Pluvial	*Private & Public Drainage Network*	*Proposed development, downstream properties and roads*	*Ranges from low to high*	*Moderate*	*Ranges from low to high*	*Appropriate drainage, SuDS and attenuation design, setting of floor level & basement entrance, overland flood routing*	Low
Ground Water	*Ground*	*Underground services, ground level of building*	*Low*	*Moderate*	*Low*	*Appropriate setting of floor level, flood routing, damp proof membranes*	Low
Human/ Mechanical Error	*Drainage network*	*Proposed development*	*High*	*Moderate*	*High*	*Setting of floor level, overland flood routing, regular inspection of SW network*	Low

Table 6 | *Summary of the Flood Risks from the Various Components*

As indicated in the above table, the various sources of flooding have been reviewed, and the risk of flooding from each source has been assessed. Where necessary, mitigation measures have been proposed. As a result of the proposed mitigation measures, the residual risk of flooding from any source is low.

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