Waterman Moylan
Engineering Consultants

Flood Risk Assessment

Mixed Use Development at Clongriffin, Dublin 13
Strategic Housing Development Application No. 2

August 2019

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1. Introduction

This report has been prepared by Waterman Moylan as part of the documentation in support of a Strategic Housing Development Planning Application for a proposed mixed-use development in Clongriffin, 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 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 errors.

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

1.1 Site Description and Proposed Development

The subject development, Strategic Housing Development Application No.2 (SHD2), is one of three concurrent applications which together consist of 15 mixed-use residential and commercial blocks, including ancillary infrastructure, with provision made for 1,950 apartment units and 22,728m² of commercial floor space. This subject SHD2 includes 3 of the proposed 15 blocks. A breakdown of the schedule of accommodation is shown in Table 1, below:

Application	Block Numbers	Total No. of Residential Units	Ancillary Facilities *(m²)*	Commercial Floor Area *(m²)*	Total Floor Area *(m²)*
Strategic Housing Development: Application No.1	*6, 8, 11, 17, 25, 26, 27, 28 and 29*	*1,030*	*2,421m²*	*2,286m²*	*105,944m²*
Strategic Housing Development: Application No.2	4, 5 and 14	500	1,094m²	3,125m²	51,840m²
Dublin City Council Planning Application	*3, 13 and 15*	*420*	*820m²*	*17,317m²*	*65,772m²*
Total	**15 Blocks**	**1,950**	**4,335m²**	**22,728m²**	**223,556m²**

***Table 1** | Schedule of Accommodation*

These three concurrent applications form part of a parent planning permission which was previously granted by Dublin City Council as part of the overall Clongriffin residential and commercial development, Reg. Ref. 0132/02, PL29N.131058. The drainage infrastructure around the subject Blocks has been constructed under the Clongriffin parent planning permission, with the roads partially constructed.

The blocks which form the three concurrent applications are highly interconnected, and as such a holistic approach has been taken in assessing the flood risk for the site.

The three blocks which form the subject development are indicated in Figure 1, below:

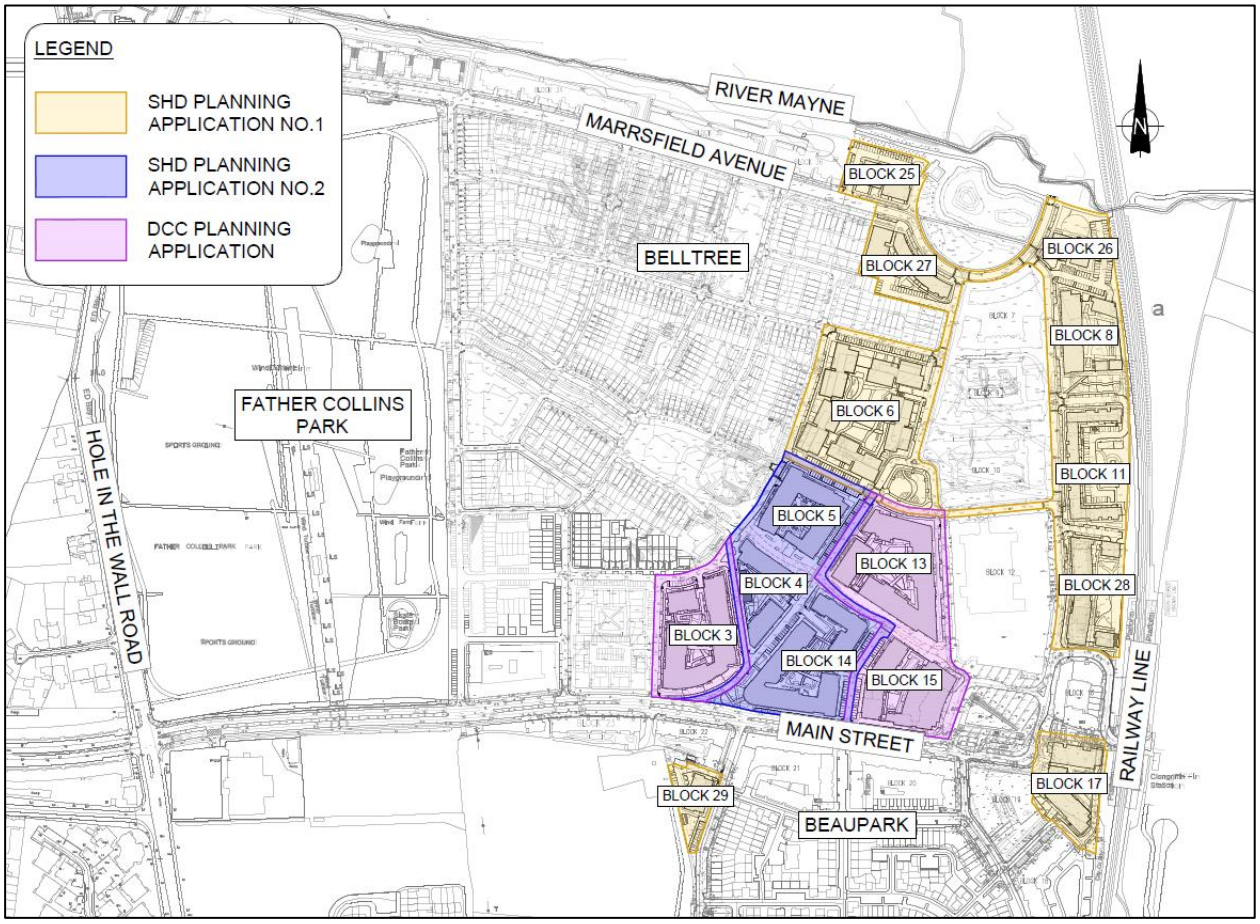


Figure 1 | *Subject Development Blocks*

The Clongriffin site is bounded to the north by the Mayne River, to the east by the Dublin–Belfast railway line, to the west by Fr. Collins Park and to the south by the Grange Road and generally slopes down towards the north-east towards the River Mayne. Refer to Figure 1, above, indicating the subject blocks located to the eastern side of the Clongriffin Development — refer also to the accompanying Waterman Moylan drawing 18-059-P2000, which shows the site location within the overall Clongriffin Development.

The proposed road levels around the overall site range from 5.6m OD Malin at the attenuation pond north of Block 26, at the north-east of the development, up to 10.6m OD Malin at Block 29 at the south-west of the development, while road levels at the subject SHD2 site range from 7.460m OD Malin at the north-eastern corner of Block 5 up to 8.391m OD Malin at the corner of Market Street and Park Street, between Blocks 4 and 5. Finished floor levels throughout the overall site range from 6.8m to 10.365m OD Malin, with a range from 7.9m to 8.375m OD Malin at the subject SHD2 site.

Finished floor levels have been set at least 200mm above the adjacent road channel line. Where we have localised low spots in the road, we have set FFLs a minimum of 300mm above the adjacent road channel line.

1.2 Background to the Report

This Flood Risk Assessment report follows the guidelines set out in the *DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management* published in November 2009. 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.

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 2 | *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.

1.2.1 Assessing Consequence

There is not a defined method used to quantify a value for the consequences of a flooding event. Therefore, in order 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 in order to determine a value for consequences. Consequences will also be categorized as low, moderate, and high.

1.2.2 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 3 | *3x3 Risk Matrix*

2. Tidal

2.1 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.

2.2 Pathway

The nearest coastline is the Irish Sea, approximately 2.5 kilometres east of the subject site.

The proposed road levels around the overall site range from 5.6m to 10.6m OD Malin, with finished floor levels between 6.8m and 10.365m OD Malin.

The Dublin Coastal Protection Project indicated that the 2002 high tide event reached 2.95m OD Malin. The subject site is therefore at least 2.61m above the highest tide recorded in the Dublin Coastal area.

Given that the site is located 2.5 kilometres inland from the Irish Sea and that there is at least a 2.61m level difference between the subject lands and the high tide 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.

In addition to the above, there are no records of any previous tidal flooding in this area and no tidal flooding is indicated on the OPW Coastal Flood maps, outlined below.

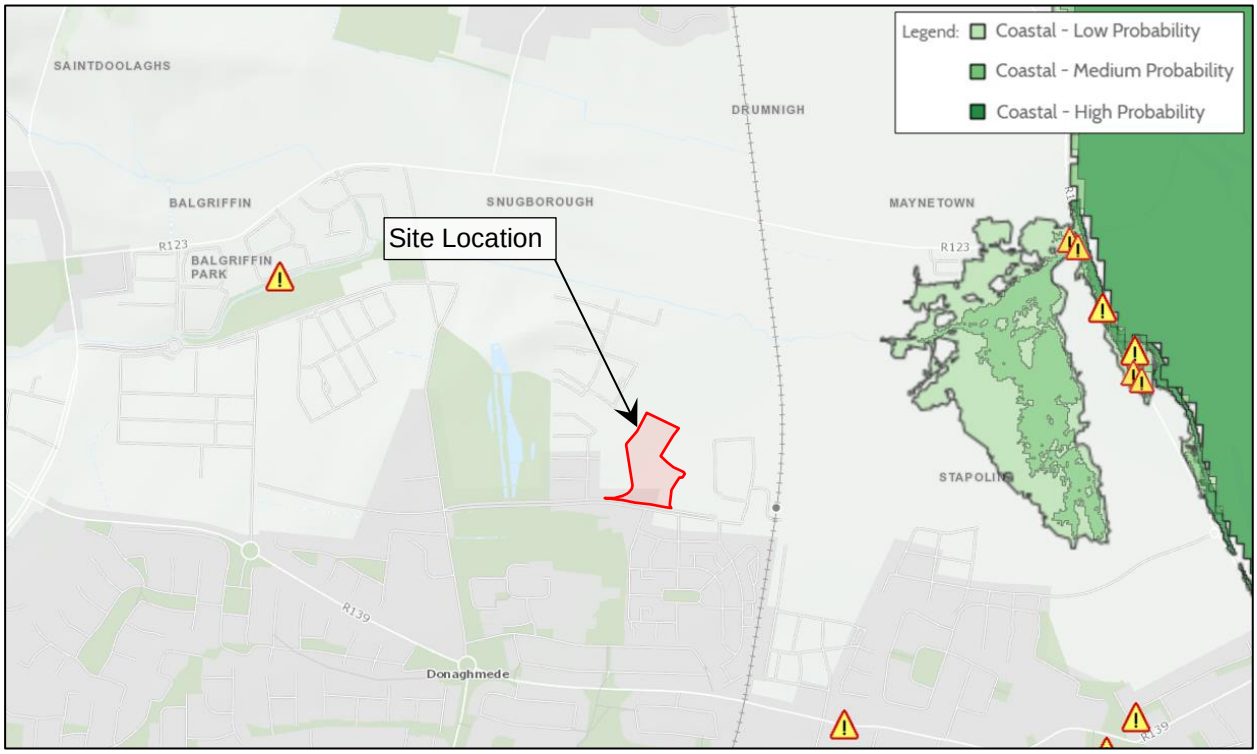


***Figure 2** | Extract of OPW's Coastal Flood Extents Map*

The OPW's Coastal Flood Extent maps outline areas at risk of tidal flooding. 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. It is again evident that the likelihood of tidal flooding is extremely remote, and no flood mitigation measures need to be implemented.

3. Fluvial

3.1 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.

3.2 Pathway

The subject site is located within the River Mayne catchment. The Mayne River traverses the lands approximately 35 metres north of the site. Figure 3, below, is an extract from the OPW's River Flood Extent maps, and outlines areas at risk of fluvial flooding. High probability flood events, as shown in the below 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).

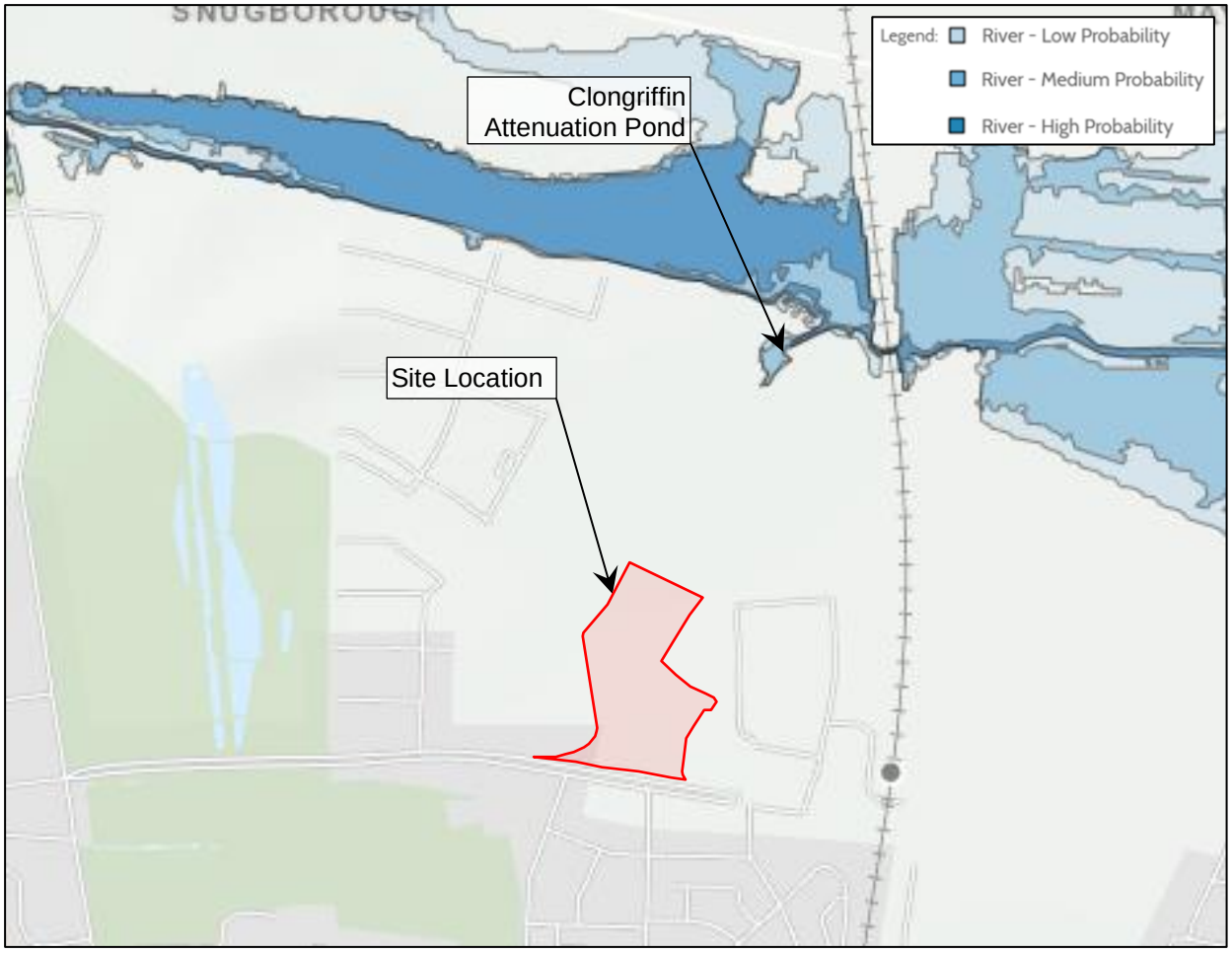
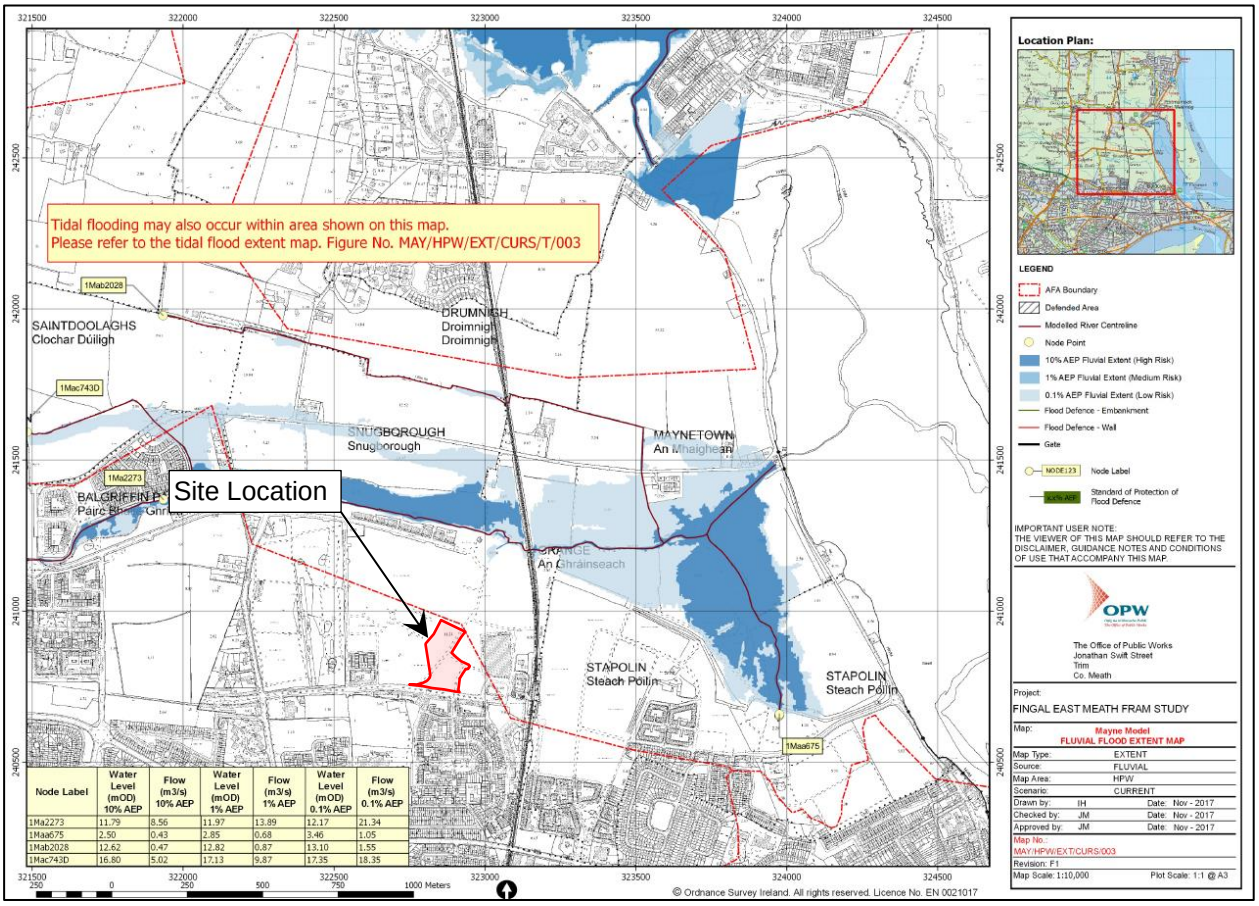


***Figure 3** | Extract of OPW's River Flood Extents Map*

The map indicates that the subject site is outside of the 0.1% AEP (1-in-1,000 year) flood plain, with the northernmost portion of the site closest to the flood plain. The fluvial flood extent map taken from the FEM FRAM Study is extracted below.



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
1Ma2273	11.79	8.56	11.97	13.89	12.17	21.34
1Maa675	2.50	0.43	2.85	0.68	3.46	1.05
1Mab2028	12.62	0.47	12.82	0.87	13.10	1.55
1Mac743D	16.80	5.02	17.13	9.87	17.35	18.35

Figure 4 | *FEM-FRAM Fluvial Flood Extent Map for River Mayne – MAY/HPW/EXT/CURS/003*

We also refer to Site 29 of the Strategic Flood Risk Assessment that forms part of the Dublin City Development Plan 2016-2022. Site 29 Flood Map is consistent with the above mentioned flood map and shows the proposed development outside of the Flood Zones A and B.

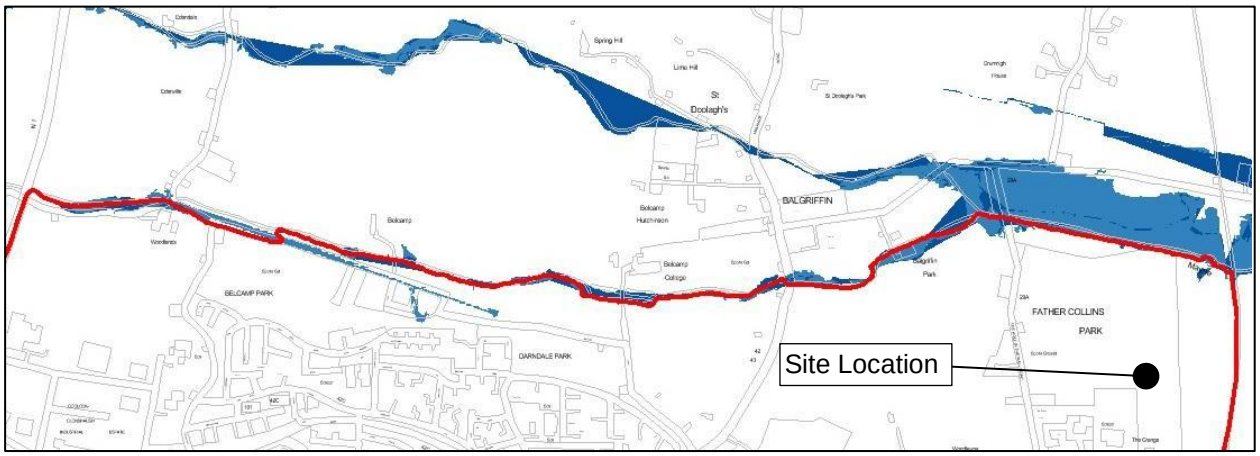


Figure 5 | *Extract from Strategic Flood Risk Assessment that forms part of the Dublin City Development Plan 2016-2022 – Site 29: Mayne*

The lowest design road level around the proposed subject SHD2 site is 7.46m OD Malin, with the lowest finished floor level at 7.9m OD Malin. The closest part of the FEM FRAM 0.1% AEP (1-in-1,000 year) flood plain to the subject site is approximately 300 metres to the north, and there is no out-of-bank flow indicated on the southern side along this section of river for the 1% AEP (1-in-100 year) flood. The highest top of bank level along this section of River is 4.6m OD Malin. This provides a 2.86m freeboard for the lowest proposed road level and 3.3m freeboard for the lowest proposed FFL from the 0.1% AEP (1-in-1,000 year) fluvial flood plain.

A risk from fluvial flooding is therefore very low and no flood mitigation measures need to be considered.

4. Pluvial

4.1 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.

4.2 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 – properties and roads
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

Table 4 | *Pathways and Receptors*

It is proposed to discharge surface water from the proposed site to the existing surface water drainage network that has been designed to accommodate the proposed development. The surface water network discharges to the River Mayne via an attenuation pond and flow control manhole located at the north of the site.

Refer to drawing 18-059-P2200 for the existing and proposed drainage layouts.

4.3 Likelihood

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

4.3.1 Surcharging of the proposed on-site drainage systems:

The proposed on-site surface water drainage sewers have been designed to accommodate flows from a 2-year return event, which indicates that on average the internal system may surcharge during rainfall events with a return period in excess of 2 years. Thus, the likelihood is high.

4.3.2 Surcharging from the existing surrounding drainage system:

There is a high likelihood of surcharging from the surrounding Clongriffin and Belltree developments, which have also been designed with surface water sewers which accommodate a 2 year return storm.

4.3.3 Surface water discharge from the subject site:

Due to the increase in hard standing area as a result of the proposed development, there is an increased likelihood of surface water discharge from the site leading to downstream flooding. As such, the likelihood can be considered moderate.

4.3.4 Overland flooding from surrounding areas:

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

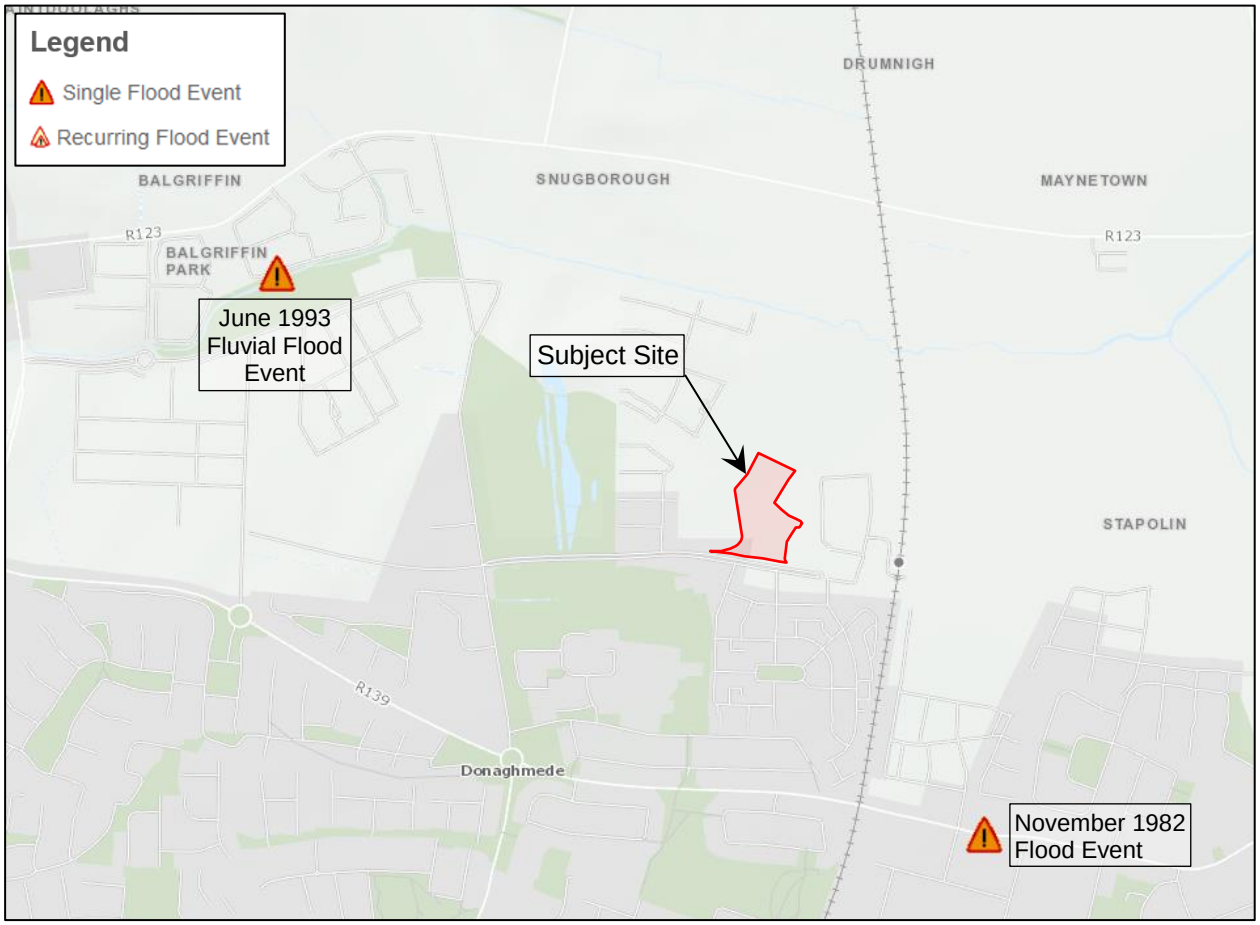


Figure 5 | *OPW National Flood Hazard Mapping*

The closest recorded flood event was at the Grange Road, approximately 500m south-east of the site, and occurred in 1982 during widespread flooding throughout the Dublin area. Another flood event occurred in 1993 approximately 1.2km west of the site, reported as fluvial flooding from the Mayne River. The flood report noted that a number of defence assets were put in place since the flood occurred, and there have been no further reported incidents of flooding.

With no recorded flood event in the immediate area that could have an impact on the subject site, it is considered that there is a low likelihood of flooding from surrounding areas.

4.3.5 Overland flooding from the subject site:

Due to the increase in hard standing area as a result of the proposed development, there is an increased likelihood of overland flooding from the site leading to downstream flooding. As such, the likelihood can be considered moderate.

4.4 Consequence

Surface water flooding would result in damage to roads and landscaped areas and possibly properties. The consequences of pluvial flooding are considered moderate.

4.5 Risk

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

4.5.1 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.

4.5.2 Surcharging from the existing surrounding drainage system:

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

4.5.3 Surface water discharge from the subject site:

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

4.5.4 Overland flooding from surrounding areas:

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

4.5.5 Overland flooding from the subject site:

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

4.6 Flood Risk Management

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

4.6.1 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. Open grassed areas with low level planting and permeable paving in the courtyards at the ground floor podium level will ensure that all podium levels will act as soft scape and will significantly slow down and reduce the amount of surface water runoff from the courtyard/podium level. Planter boxes, planted areas and permeable paving areas will also take surface water runoff from the down pipes fronting onto the courtyard areas.

Green roofs are proposed for portions of all three blocks, consisting of 75mm substrate with a sedum blanket. The paved areas on these roofs will drain to the planted areas.

Filter drains are proposed around the perimeter of each block. Rainwater pipes from the roofs of the surrounding buildings will be directed to the filter. The filter drains consist of stone trenches that provide for linear collection and treatment of surface water, allowing for some infiltration into the ground. The filter drains will discharge into collector drains before eventually discharging into the storm sewer network.

Permeable paving will be utilised at roadside parking spaces, private courtyard parking spaces and courtyard footpaths, providing some treatment volume, with underlying perforated pipes connecting to the storm water sewer network within the roads.

These proposed source and site control devices will intercept and significantly slow down the rate of runoff from each block to the on-site drainage system, reducing the risk of surcharging. Refer to SuDS drawings P2220 to P2222.

4.6.2 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 Clongriffin regional attenuation pond at the north of the site – refer to overland flood route drawing P2240. The site slopes generally towards the pond, with some minor localised low and high points in the road levels. Were the surrounding drainage system to surcharge, localised ponding of surface water may occur between high points. The risk to the surrounding buildings is mitigated by setting finished floor levels at least 200mm above the adjacent road channel line. Where we have localised low spots in the road, we have set FFLs a minimum of 300mm above the adjacent road channel line.

4.6.3 Surface water discharge from the subject site:

Surface water discharge from the subject site is intercepted and significantly slowed down through the use of source control devices, as described in Section 4.6.1 above, minimising the risk of pluvial flooding from the subject site. Excess flows from the development are attenuated within the regional attenuation pond (6,400m^3) which has been designed and approved by Dublin City Council to facilitate 100-year attenuation of the entire Clongriffin Development, before discharging to the River Mayne at a controlled rate of 249 l/s.

4.6.4 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 buildings, as described in Section 4.6.2 above.

4.6.5 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 4.6.1 above, and by providing overland flood routing through the site with raised finished floor levels, providing sufficient freeboard as described in Section 4.6.2 above.

4.7 Residual Risk

As a result of the design measures detailed above in Section 4.6, there is a low residual risk of flooding from each of the surface water risks.

5. Groundwater

5.1 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.

5.2 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.

5.3 Receptor

The receptors for ground water flooding would be the underground services, buildings and road areas within the proposed development.

5.4 Likelihood

During periods with prolonged rainfall the groundwater can rise. Geological Survey Ireland (GSI) produces a wide range of datasets, including groundwater vulnerability mapping. From the GSI groundwater vulnerability map, extracted below, the site itself lies within an area with low groundwater vulnerability, though there is an area of high vulnerability south of block 3 (part of the DCC planning application) and block 14 (part of the subject SHD2 application), and north of block 29 (part of the SHD1 application) at the south-west of the site.

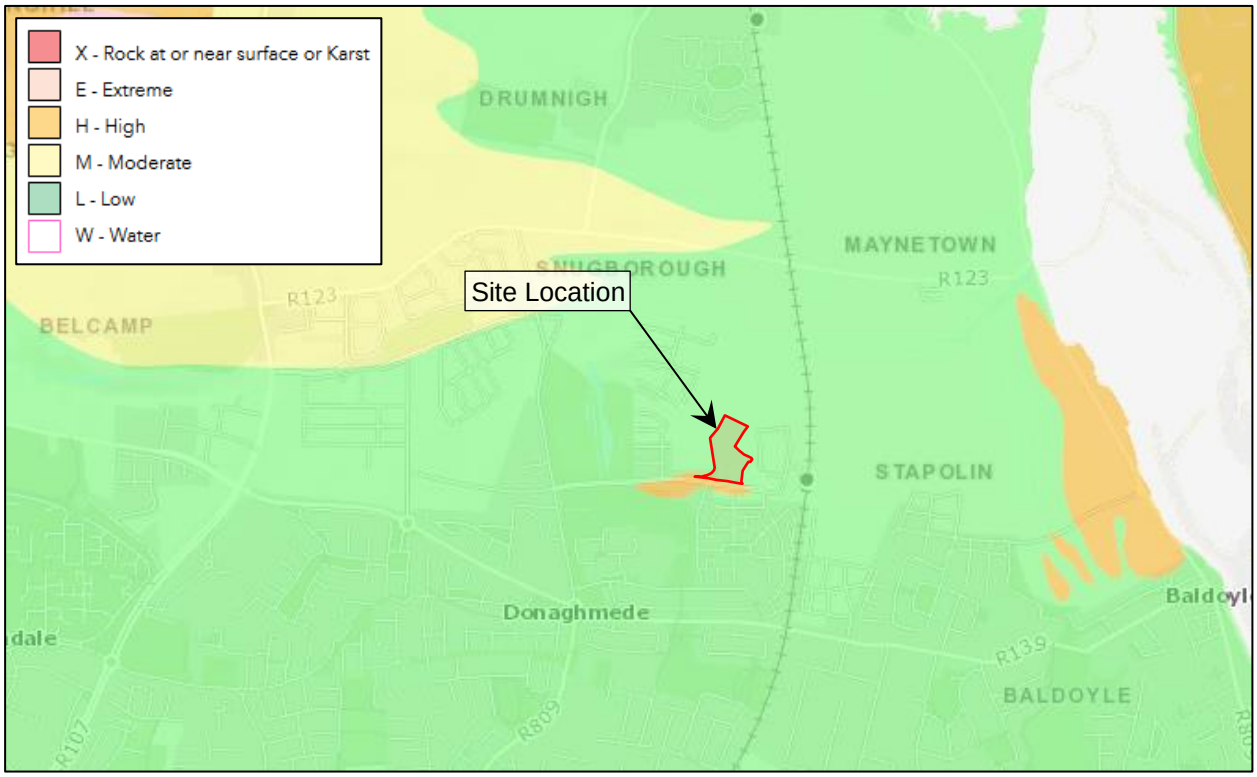


Figure 6 | *Groundwater Vulnerability Map*

With the entire site falling within an area of low groundwater vulnerability, and with no known history of ground water / springs seeping through the ground in this area, the likelihood of groundwater rising through the ground and causing potential flooding on site during prolonged wet periods is low.

5.5 Consequence

The consequence of ground water flooding would be some minor temporary seepage of ground water through the ground around the proposed buildings and landscaped areas. Underground services could also be inundated from high water tables. Therefore, the consequence of ground water flooding occurring at the proposed development is considered moderate.

5.6 Risk

There is a low risk of ground water flooding as the likelihood is low and the consequence is moderate.

5.7 Flood Risk Management

Finished floor levels have been set above the road levels, as described in Section 4.6.2, to ensure that any seepage of ground water onto the development does not flood into the blocks. In the event of ground water flooding on site, this water can escape from the site via the overland flood routing, also described in Section 4.6.2.

5.8 Residual Risk

There is an extremely low residual risk of flooding from ground water.

6. Human/Mechanical Errors

6.1 Source

The subject lands will be drained by an internal private storm water drainage system connected to the existing surface water network, which discharges to the Clongriffin regional attenuation pond at the north-east of the Clongriffin scheme before discharging to the Mayne River at a controlled rate of 249 l/s, as permitted under the parent planning permission. The internal surface water network is a source of possible flooding were it to become blocked.

6.2 Pathway

If the proposed private drainage system blocks this could lead to possible flooding within the private and public areas.

6.3 Receptor

The receptors for flooding due to human/mechanical error would be the apartment/commercial blocks and the roads.

6.4 Likelihood

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

6.5 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.

6.6 Risk

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

6.7 Flood Risk Management

In the event of the surface water system surcharging, the surface water can still escape from the site by overland flood routing, as described in Section 4.6.2, without causing damage to the proposed blocks. The risk to the surrounding buildings is mitigated by setting finished floor levels at least 200mm above the adjacent road channel line. Where we have localised low spots in the road, we have set FFLs a minimum of 300mm above the adjacent road channel line.

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

6.8 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.

7. Conclusions and Recommendations

The subject lands have been analysed for risks from tidal flooding from the Irish Sea and from the Mayne River, fluvial flooding from the Mayne River, pluvial flooding, ground water and failures of mechanical systems. Table 4, below, presents the various residual flood risks involved.

Source	Pathway	Receptor	Likelihood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	*None*	*Proposed Roads & Houses*	*Extremely Low*	*None*	*Negligible*	*None*	Extremely Low
Fluvial	*River Mayne*	*Proposed Roads & Houses*	*Extremely Low*	*None*	*Negligible*	*None*	Low
Pluvial	*Private and Public Drainage Network and Overland*	*Proposed Roads & Buildings*	*Ranges from Low to High*	*Moderate*	*Ranges from Low to High*	*Appropriate drainage and SuDS design, overland flood routing and setting of floor levels*	Low
Ground Water	*Ground*	*Underground Services, Roads & Buildings*	*Low*	*Moderate*	*Low*	*Appropriate overland flood routing and setting of floor levels*	Extremely Low
Human/ Mechanical Error	*Drainage network*	*Proposed Roads & Buildings*	*High*	*Moderate*	*High*	*Overland flood routing, setting of floor levels and regular inspection of SW network.*	Low

Table 5 | *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.

UK and Ireland Office Locations