Waterman Moylan
Engineering Consultants

Flood Risk Assessment

Proposed Residential Development Site at Cross Guns Bridge, Phibsborough, Dublin 7

January 2021

Waterman Moylan Consulting Engineers Limited
Block S, EastPoint Business Park, Alfie Byrne Road, Dublin 3
www.watermangroup.com

Waterman Moylan
Engineering Consultants

Client Name: Bindford Ltd.
Document Reference: 20-011r.002
Project Number: 20-011

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
No.1	Jan. '21	S Joyce	B Gallagher	J Gibbons

Comments

Disclaimer

Content

1. Introduction 5

1.1 Site Location 5

1.2 Proposed Development 5

1.3 Site Description 6

1.4 Background to the Report 6

1.5 Review of Strategic Flood Risk Assessment (SFRA) for Dublin City Council Development Plan 2016-2022 7

2. Tidal – Irish Sea 11

2.1 Source 11

3. Fluvial 12

3.1 Source 12

4. Pluvial 13

4.1 Source 13

4.2 Pathways & Receptors 13

4.3 Likelihood 13

4.4 Consequence 15

4.5 Risk: 15

4.6 Flood Risk Management 15

4.7 Residual Risk 16

5. Ground Water 17

5.1 Source 17

5.2 Pathway 17

5.3 Receptor 17

5.4 Likelihood 17

5.5 Consequence 17

5.6 Risk 17

5.7 Flood Risk Management 17

5.8 Residual Risk 17

6. Human / Mechanical Errors 18

6.1 Source 18

6.2 Pathway 18

6.3 Receptor 18

6.4 Likelihood 18

6.5 Consequence 18

6.6 Risk 18

6.7 Flood Risk Management 18

6.8 Residual Risk 18

7. Conclusions and Recommendations 19

1. Introduction

This Flood Risk Assessment (FRA) has been prepared by Waterman Moylan as part of the documentation in support of a Strategic Housing Development application for a proposed residential development at Cross Guns Bridge, Phibsborough, Dublin 7.

This FRA 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 and groundwater.

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

1.1 Site Location

The site is located adjacent to the Royal Canal (a manmade, managed waterway), along the R108/Phibsborough Road in Phibsborough, Dublin 7. It is bounded to the north by the Royal Canal, to the east by the R108/Phibsborough Road and to the south and west by existing residential developments.

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

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

1.2 Proposed Development

Bindford Ltd. intend to apply to An Bord Pleanála for permission for a strategic housing development at this c. 0.73 ha site at Cross Guns Bridge, Phibsborough, Dublin 7.

The proposal is for a Strategic Housing Development for Build -To-Rent apartments and will comprise the demolition of all derelict buildings on site and the construction of a new residential development comprising

3 no. blocks ranging in height up to 12 storeys consisting of 205 no. dwellings and associated residential amenities, basement and surface carparking with vehicular and pedestrian access from the eastern end of the site off Phibsborough Road. Additional pedestrian only accesses to the north of the site off the Royal Canal Way. A new café/ retail area will be located at ground floor level of block C along with a new public open space to the east of the site. All associated site development works, landscaping and boundary treatment, children's play area, cycle parking, bin stores, substation, and services provision. A full description is set out in the statutory notices.

1.3 Site Description

The total area of the proposed development is approximately 0.73ha. The site falls from west to east ranging in levels from 28.31m to 25.95m OD Malin, as well as from north to south ranging in levels from 29.25m to 28.11m OD Malin.

1.4 Background to the Report

This FRA 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 included in Table 1 of the above guidelines; namely:

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, 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:

Table 1: OPW Risk 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.

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.

1.4.1 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 be categorised as low, moderate and high.

1.4.2 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.

Table 2: 3x3 Risk Matrix

		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 3.2 of the Planning System and Flood Risk Management Guidelines for Planning Authorities gives a detailed classification of vulnerability for different developments. This can be seen in Figure 2, below. Buildings classified as residential are defined highly vulnerable developments. As this land is within Flood Zone C, this is considered an appropriate land use.

1.5 Review of Strategic Flood Risk Assessment (SFRA) for Dublin City Council Development Plan 2016-2022

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

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. Sequential approaches are already established and working effectively in other areas in the plan making and development management processes. The sequential approach described in Fig. 2 should be applied to all stages of the planning and development management process. It is of particular importance at the plan making stage but is also

applicable in the layout and design of development within a specific site at the development management stage.

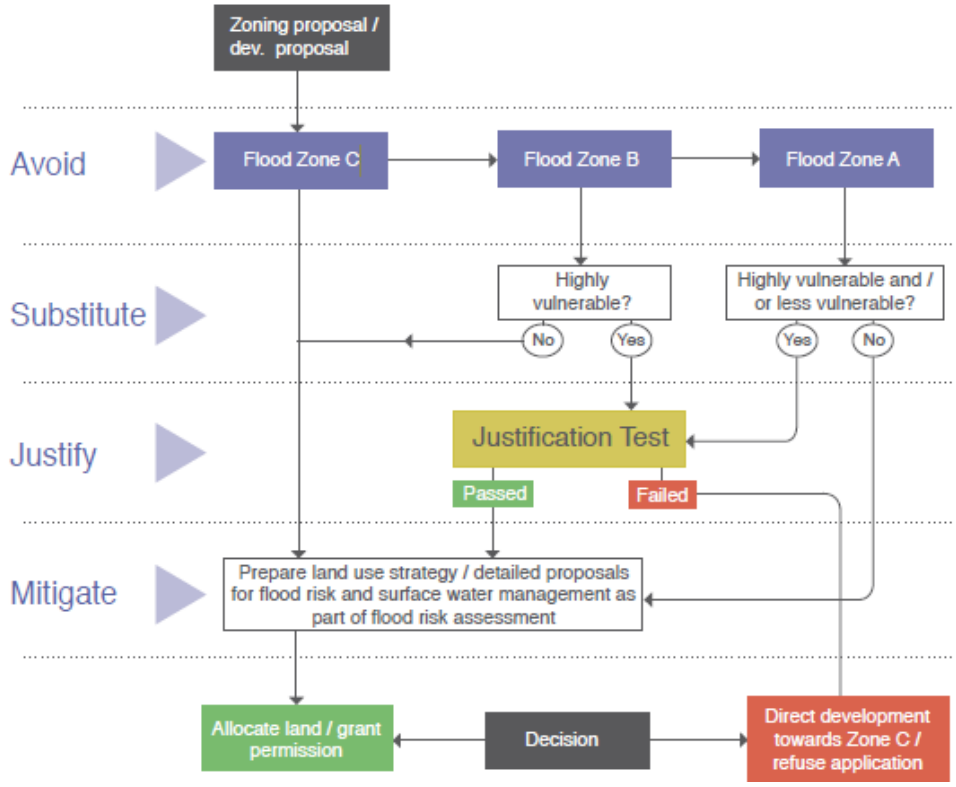


Figure 2: Sequential Approach

Figure 3 below lists the vulnerability classes and the appropriate land uses for each type.

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 3: Vulnerability Classes

The proposed development contains land uses classified as both highly vulnerable and less vulnerable development and is located within Flood Zone C: Low Probability of Flooding. Therefore the development doesn't require a Justification Test as the development is deemed appropriate.

	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

Table 1.2 Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.[3]

All drainage and flood risk calculations include 20 percent climate change in accordance with Dublin City Council Requirements. The surface water attenuation calculations with 20% climate change factor are provided in Appendix A.

2. Tidal – Irish Sea

2.1 Source

The Irish Sea is approximately 3.06 kilometres east of the subject site. The proposed road levels around the site are on a range from 28.10m to 25.95m OD Malin, the finished floor levels on the site are 28.50 – 28.15m OD Malin.

The Dublin Coastal Protection Project indicated that the 2002 high tide event reached 2.95m OD Malin. Therefore, subject site is 25.20m above the highest tide recorded in the Dublin Coastal area.

The Royal Canal outfalls into the River Liffey, which in turn outfalls into the Irish Sea. Subsequently, there is no direct pathway between the Irish Sea and the subject site located adjacent the Royal Canal.

Due to the above-mentioned characteristics, a risk from tidal flooding is considered extremely low and no flood mitigation measures need to be implemented.

3. Fluvial

3.1 Source

Fluvial flooding is the result of a river exceeding its capacity and excess water spilling out onto the adjacent floodplain. The subject site is not located in the immediate vicinity of any river. The adjacent Royal Canal is a manmade, managed waterway and does not pose a flood risk.

Figure 4: Extent of Fluvial Flooding (Image taken from DCC Strategic Flood Assessment (SFRA))

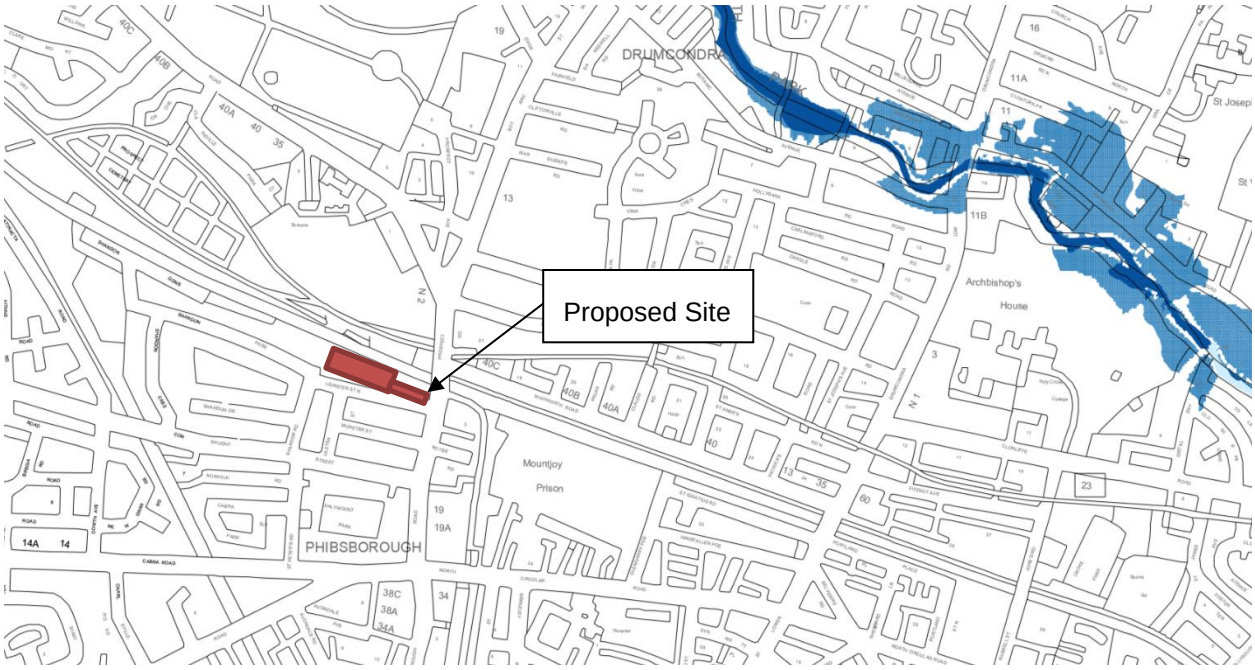


Figure 4 above shows the SFRA map found in the Dublin City Council Strategic Flood Risk Assessment. The site is located c. 1km from the nearest river and is not at risk to fluvial flooding.

Past flood events recorded show the nearest flood was approximately 1km away from the subject site. This flood reached a level of 8.11m OD Malin. The lowest finished floor level on site is 28.15m OD Malin. Given that the nearest fluvial flooding incident is approximately 1km away from the subject site and that the projected flood level is at least 20.04m lower than the proposed finished floor level within the subject site, the risk of fluvial flooding is considered extremely low.

4. Pluvial

4.1 Source

The source of pluvial flooding is from heavy rainfall.

4.2 Pathways & Receptors

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

Table 3: Pluvial Pathway and Receptor Summary

	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

It is proposed to discharge surface water from the proposed site to the existing storm sewer network. Refer to Drawing No. 20-011-P200 for the proposed drainage layout.

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 system:

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 moderate.

4.3.2 Surcharging of the existing surrounding drainage system

There are no recorded instances of flooding on the site. The surface water drainage from the proposed development will be attenuated with a restricted outflow to the combined water sewer, therefore reducing the volume of run-off to the sewer from the current existing flows. The likelihood of flooding due to surcharging the existing drainage network is therefore considered low. Excess storm water arising during periods of heavy rainfall will be stored on site within an attenuation tank located below ground.

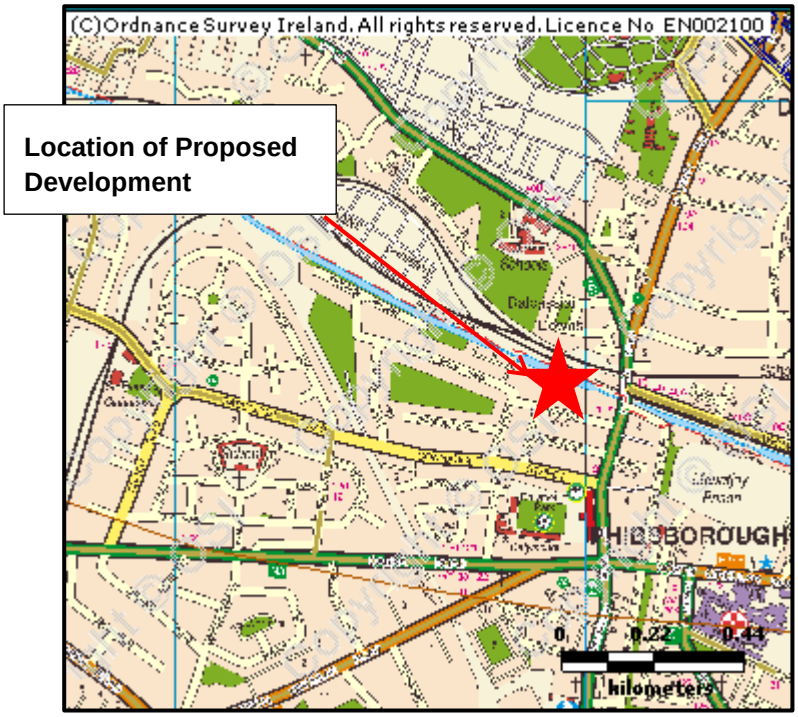
4.3.3 Surface water discharge from the subject site

The proposed development site is already 100% hard surfaced. The development as designed will increase the permeable area due to the installation a green roofs and landscaped areas which will reduce and slow down the run-off from the site. The result is that there is no likelihood of an increase of surface water discharge from the site leading to downstream flooding. The likelihood is considered low.

4.3.4 Overland flooding from surrounding areas

The OPW records for predictive and historic flood maps and benefiting land maps have been consulted for recorded flood events in the vicinity of the subject site. A map showing all flood events within the immediate vicinity of the subject site was downloaded from the OPW website and is provided below in Figure 4, below.

Figure 5: OPW Land Benefiting Maps and Historic Flood Maps



There are no flood events that have been recorded in the immediate vicinity of the subject area. Therefore, the likelihood of flooding from surrounding areas is considered very low.

4.3.5 Overland flooding from the subject site

The proposed development site is already 100% hard-surfaced. The proposed development will include a green roof and landscaped areas together with an attenuation system for surface water during periods of heavy rainfall. In this regard, there will be no increase in hard standing area as a result of the proposed development, as such there is no likelihood of increased overland flooding from the site leading to downstream flooding. The likelihood is considered low. Please refer to overland flood route drawing No. 20-011-P350 which is enclosed as part of this overall submission.

4.4 Consequence

The consequence of surface water flooding arising from the 5 pathway types would result in moderate to high damage to roads and properties

4.5 Risk:

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 remains high.

4.5.2 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 moderate.

4.5.3 Surface water discharging from the subject site

With a low likelihood and high consequence of flooding downstream of the site due to excess discharge surface water from the 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 surrounding areas, the resultant risk remains moderate.

4.5.5 Overland flooding from the subject site

With a low likelihood and high 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 sustainable urban drainage systems (SUDS) devices. The risk from any surcharged surface water is reduced from finished floor levels designed generally 300mm above the adjacent road levels.

4.6.2 Surcharging from the existing surrounding drainage systems

The risk from flooding from surcharging of the existing surface water network is further reduced by setting finished floor levels generally above the adjacent road levels and with overland flood routing along the road network.

4.6.3 Surface water discharging from the subject site

Surface water discharging from the development will be limited by a hydro break to ensure the maximum discharge rate from the site is limited to 2 l/s/ha. For surface water layout please refer to Drawing No. 20-011-P200.

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 development. Services ducts and voids in the new basement walls will be properly sealed to prevent the ingress of groundwater into the basement which will provide protection for the proposed buildings and basement.

4.6.5 Overland flooding from the subject site

The risk is minimised by providing overland flooding through the development with raised finished floor levels, generally 300mm above the adjacent road network.

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. The flood risk management measures set out in Section 4.6 will minimise the risk, ensuring that any overland flooding from surface water will result in the flooding of the internal roads only.

5. Ground Water

5.1 Source

During periods with prolonged rainfall the groundwater can seep to above ground level.

5.2 Pathway

During periods with prolonged rainfall there is a possibility that the groundwater level would rise. It is possible that groundwater could enter the building through voids in the basement walls which would be susceptible to groundwater ingress.

5.3 Receptor

The receptors would be the basement of the proposed development.

5.4 Likelihood

Due to cut on site, there is a moderate possibility that the ground water could infiltrate the basement.

5.5 Consequence

The consequence of groundwater levels increasing would be seepage of ground water into the basement.

5.6 Risk

There is a moderate risk of groundwater flooding into the basement.

5.7 Flood Risk Management

The risk of ground water flooding into the basement requires management both at construction stage and when the basement is developed.

To alleviate the risk of flooding during basement construction the contractor shall develop an appropriate dewatering scheme to keep the basement / excavations free from water. Any water discharged from site during construction shall be monitored and tested in accordance with the requirements of Dublin City Council. An appropriate discharge licence will also be acquired from Dublin City Council in respect of discharges from dewatering operations.

To alleviate the risk of flooding when the basement is developed all services ducts and voids in the basement walls will have to be properly sealed to prevent the ingress of groundwater. The basement will be tanked to prevent ingress of water through the structure. A drainage system will be installed to collect water in the basement, which will be pumped to the public combined sewer. The basement will be monitored and if any leaks arise, they will be injected to prevent the leak.

5.8 Residual Risk

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

6. Human / Mechanical Errors

6.1 Source

The site will be drained by an internal private storm water drainage system which discharges to the existing surface water network via proposed flow control, installed at the downstream manhole of the proposed attenuation tank within the site. This internal surface water network is the source of possible flooding from the system if it was to block.

6.2 Pathway

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

6.3 Receptor

The receptors are the buildings and roads.

6.4 Likelihood

There is a high possibility of flooding on the subject site if the surface water network was to block.

6.5 Consequence

The surface water network would surcharge and overflow through gullies and manhole lids.

6.6 Risk

There is a medium risk of surface water overflowing onto the surrounding road network, should the surface water network block.

6.7 Flood Risk Management

As described in Section 4.6, levels on site have been designed such that in the event of the surface water system surcharging, surface water can still escape from the site by overland flood routing without damaging any properties. The surface water network would need to be unblocked and maintained should a blockage occur.

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 site has been analysed for risks from flooding from the Irish Sea, fluvial flooding, pluvial flooding, ground water and failures of mechanical systems. Through careful design and appropriate mitigation measures the risks and consequences of flooding have been mitigated across the development.

Surface water runoff from the site is limited to 2 l/s and does not impact on developments upstream or downstream of the subject site.

Table 4: Summary of the Flood Risks from the Various Components

Source	Pathway	Receptor	Likelihood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	None	Proposed Development	Low	None	Negligible	None	**Extremely Low**
Fluvial	None	Proposed Development	Low	High. Flooding of the proposed dwellings and roads.	Moderate risk of minor to severe damage to dwellings	Appropriate drainage design, over land flood routing and setting of floor & site levels	**Extremely Low**
Pluvial	Private and Public Drainage Network	Proposed Development	Low	Moderate. Flooding of the proposed dwellings and roads.	Low risk of minor to severe damage to dwellings	Appropriate drainage design, over land flood routing and setting of floor & site levels	**Low**
Ground Water	Ground	Proposed Development	Moderate	Moderate. Ground water ingress into basement	Moderate risk of damage to basement level	Seal all service ducts and voids through the basement walls	**Low**
Human / Mechanical Error	Drainage network	Proposed Development	Moderate	Moderate. Surcharging of surface water network resulting in flooding of the property	Moderate risk of minor damage to dwellings	Appropriate drainage design, over land flood routing and setting of floor levels	**Low**

Therefore by introduction the proposed mitigation methods into this development, there are no reasons to withhold planning permission on grounds of flooding. The site is located wholly in Flood Zone C and is not as risk of flooding.

APPENDICES

A. Surface Water Attenuation Calculations

Column1	Proposed Developme
Site Area (Catchment) – Ha	0.730
Impermeable Area - Ha	0.585
% Hardstanding	80%
SAAR - mm	739
SOIL Index	0.3
Climate Change	20%

Soil Type	SOIL
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

QBAR (50 Hectares) 97.09 l/s
QBAR per Hectare 1.94 l/s/Ha

Column1	Proposed Developme nt
Site Area (Catchment)	0.73
$Qbar_{rural}$	2.00

Imp Area 5850

Rainfall (mm) https://www.met.ie/climate/services

Duration	Insert Rainfall Data					
(min)	1	5	10	20	50	100
30	7.6	12.7	15.7	19.2	24.7	29.8
60	9.9	16.2	19.9	24.2	30.8	36.9
120	12.9	20.7	25.3	30.4	38.4	45.6
240	16.8	26.5	32	38.2	47.8	56.4
360	19.6	30.5	36.8	43.7	54.3	63.8
720	25.6	39	46.6	55	67.7	78.9
1,440	33.3	49.9	59.1	69.1	84.3	97.6
2,880	40.1	58.4	68.4	79.1	95.1	109.1

Inflow (m3)

Duration	Return Period (Years)					
(min)	1	5	10	20	50	100
30.00	48.91	81.72	101.03	123.55	158.94	191.76
60.00	63.71	104.25	128.06	155.73	198.20	237.45
120.00	83.01	133.20	162.81	195.62	247.10	293.44
240.00	108.11	170.53	205.92	245.82	307.59	362.93
360.00	126.13	196.27	236.81	281.21	349.42	410.55
720.00	164.74	250.97	299.87	353.93	435.65	507.72
1,440.00	214.29	321.11	380.31	444.66	542.47	628.06
2,880.00	258.04	375.80	440.15	509.01	611.97	702.06

Outflow (m3)

Duration	Return Period (Years)					
(min)	1	5	10	20	50	100
30.00	3.60	3.60	3.60	3.60	3.60	3.60
60.00	7.20	7.20	7.20	7.20	7.20	7.20
120.00	14.40	14.40	14.40	14.40	14.40	14.40
240.00	28.80	28.80	28.80	28.80	28.80	28.80
360.00	43.20	43.20	43.20	43.20	43.20	43.20
720.00	86.40	86.40	86.40	86.40	86.40	86.40
1,440.00	172.80	172.80	172.80	172.80	172.80	172.80
2,880.00	345.60	345.60	345.60	345.60	345.60	345.60

Storage Reqd. (m3)

Duration	Return Period (Years)					
(min)	1	5	10	20	50	100
30.00	45.31	78.12	97.43	119.95	155.34	188.16
60.00	56.51	97.05	120.86	148.53	191.00	230.25
120.00	68.61	118.80	148.41	181.22	232.70	279.04
240.00	79.31	141.73	177.12	217.02	278.79	334.13
360.00	82.93	153.07	193.61	238.01	306.22	367.35
720.00	78.34	164.57	213.47	267.53	349.25	421.32
1,440.00	41.49	148.31	207.51	271.86	369.67	455.26
2,880.00	0.00	30.20	94.55	163.41	266.37	356.46

UK and Ireland Office Locations