43-50 Dolphins Barn, Dublin 8, Flood Risk Assessment

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The Iveagh Trust

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Abbreviation

AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DoHELG	Department of the Environment, Heritage and Local Government
DTM	Digital Terrain Model
FB	Freeboard
FFL	Finish Floor Levels
FRA	Flood Risk Assessment
FSR	Flood Studies Report
GSI	Geological Survey of Ireland
LiDAR	Light Detection and Ranging
NIFM	National Indicative Fluvial Mapping
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
RR	Rainfall-Runoff
RMS	Root Mean Square
SAAR	Standard Average Annual Rainfall (mm)
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Urban Drainage System
WL	Water Level

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009), the proposed development must undergo a Flood Risk Assessment (FRA) to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference

JBA Consulting was appointed to prepare a Flood Risk Assessment (FRA) for the proposed residential development at Dolphins Barn located in Dublin 8. The report was prepared in response to a request by The Iveagh Trust to undertake an FRA for the site.

1.2 Flood Risk Assessment Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk;
- Develop an appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the 2009 OPW / DECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Development proposal

The Iveagh Trust intend to apply to Dublin City Council for permission for a Large- Scale Residential Development on a site of c.0.358 ha at 43- 50 Dolphins Barn Street, Dublin 8.

The site is bound by Dolphin's Barn Street to the east, No. 51 Dolphin's Barn Street to the northeast, No. 7 Poole Terrace to the south and boundaries of rear gardens of the residential properties located on Reuben Street and Emerald Square to the west and north of the application site respectively. The proposed development consists of the following:

- The demolition of all existing buildings on site (comprising the former factory building to the rear of the site and buildings which front onto Dolphin's Barn Street (No's 43-50)), which have a total gross floor area of c.3,243.5 sqm.
- The construction of a 1-9 storey Large Scale Residential Development (LRD) comprising 119 no. apartments (70 no. 1 bed units and 49 no. 2 bed units) and a community hub space at ground floor level totalling c.523.5 sqm.
- All apartments are provided with balconies/terraces, which are located on the eastern, western, southern and northern elevations of the building.
- The proposal includes external communal open space areas (c.707 sqm) at ground floor level, and provision of PV panels at roof level.
- The proposal provides a total of 15 no. car parking spaces (12 no. for residents, 2 no. for the community hub, including 1 no. accessible parking space, and 1 no. car sharing space). 172 no. cycle parking spaces are provided for residents, and 60 no. cycle parking spaces are provided for visitors to the residential element of the development. 2 no. long stay cycle parking spaces, and 6 no. short stay cycle parking spaces are provided associated with the community hub element of the development.
- The proposal includes for alterations and upgrade of the site boundary walls / treatment.
- The proposal includes 1 no. shared pedestrian/ vehicular entrance point from Dolphin's Barn Street, alterations to the public footpath/street along Dolphins Barn Street, the provision of 2 no. ESB sub-station's, plant and storage rooms, a comms room, a LV switch room, a life safety room, bin stores and all associated and ancillary works.
- The associated site and infrastructural works include provision for water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works including hard and soft landscaping; blue/green roofs; boundary treatment; internal roads and footpaths; electrical services; and all associated site development works above and below ground.
- The application may be inspected online on the following website set up by the applicant: www.dolphinsbarnstreetlrd.ie

The associated site and infrastructural works include provision for water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all

landscaping works; blue/green roofs; boundary treatment; internal roads and footpaths; electrical services; and all associated site development works.

Refer to Figure 1-1 for the proposed site layout.

Figure 1-1 Site plan

1.4 Report Overview

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information on flood risk. Section 4 provides initial assessment of flood risk and mitigation measures. The conclusion is provided in Section 5.

2 Site Background

2.1 Location

This section provides background information on the proposed redevelopment at 43-50 Dolphins Barn Street in Dublin 8. The site is located in the administrative jurisdiction of Dublin City Council. The site is bound by Dolphin's Barn Street to the east, No. 51 Dolphin's Barn Street to the northeast, No. 7 Poole Terrace to the south and by the rear garden boundaries of the residential properties located on Reuben Street and Emerald Square to the west and north of the application site. The application site currently contains a group of vacant and derelict terrace buildings (No's 43, 44, 45, 46, 47, 48/48A, 49 and 50) fronting onto Dolphin's Barn Street.

Figure 2-1 Vacant and Derelict Buildings (Nos. 43-50) along Dolphin's Barn Street

2.2 Watercourses

The Grand Canal is the primary hydrological structure within the region. It originates from the Grand Canal Dock adjacent to the River Liffey, extends toward the River Shannon, and its course approaches the designated redevelopment area, flowing within 333 meters to the south of the proposed site at Parnell Road. The River Poddle is another significant fluvial feature within the adjacent hydrological system. The River Poddle originates in the southwest of County Dublin, specifically in the Tymon Park area northwest of Tallaght, within South Dublin County. It flows northward, passing 902 meters west of the site, and empties into the River Liffey at Usher's Quay in central Dublin. The Poddle covers a

catchment area of approximately 16.4 square kilometres. Another important river in the vicinity of the proposed area is the River Camac, a significant tributary of the River Liffey. It originates in the Dublin Mountains at Mount Seskin near the village of Brittas, flows through Saggart, Clondalkin, and Inchicore, and merges with the River Liffey immediately downstream of Heuston Station. It flows 873 meters northwest of the proposed site.

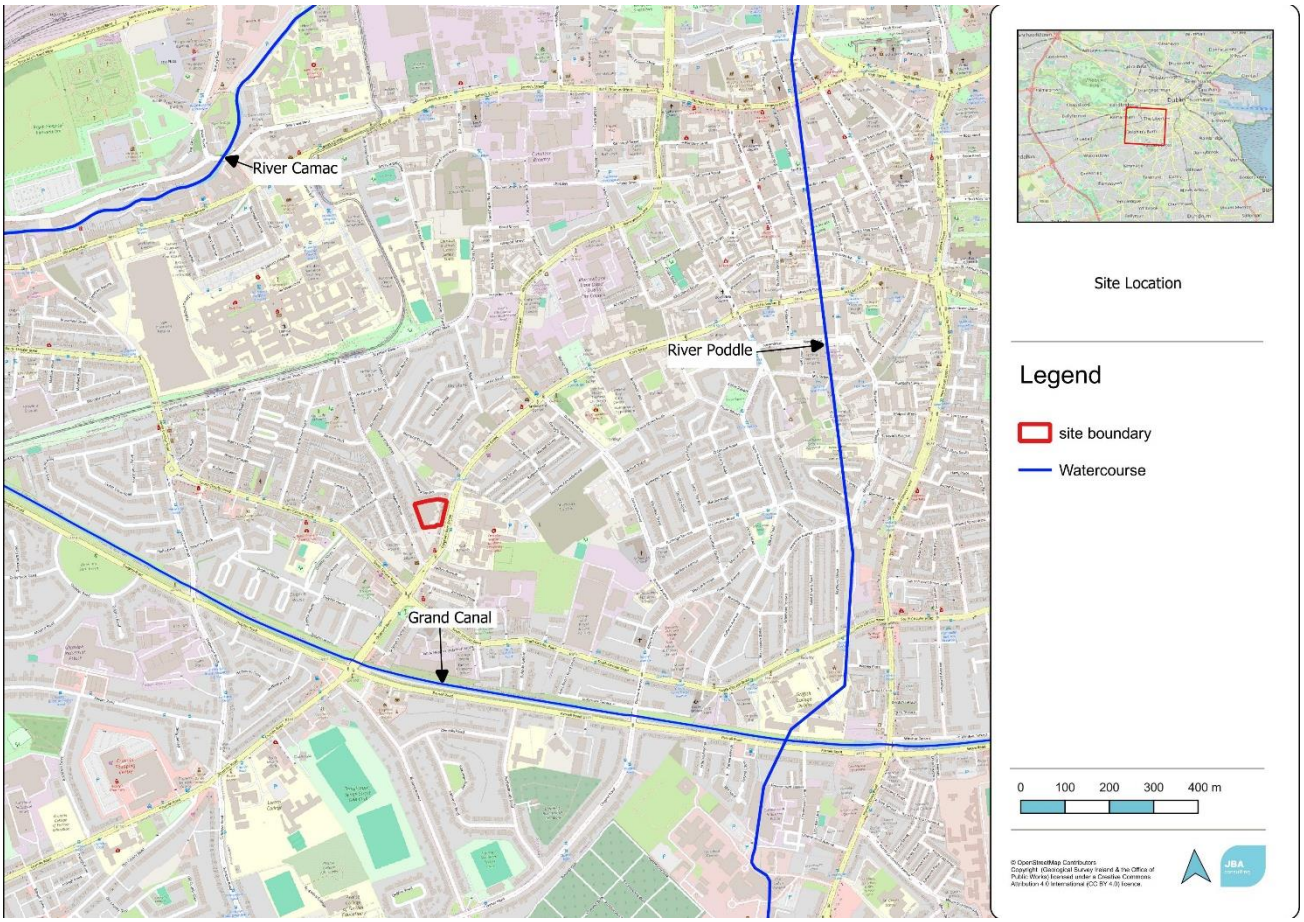


Figure 2-2:Watercourses and Site Location

2.3 Site Geology

The groundwater and geological maps of the site, provided by the Geological Survey of Ireland (GSI), have been studied. The underlying bedrock at the site is Calp, described as dark grey to black limestone & shale. The subsoil at the site is made ground.

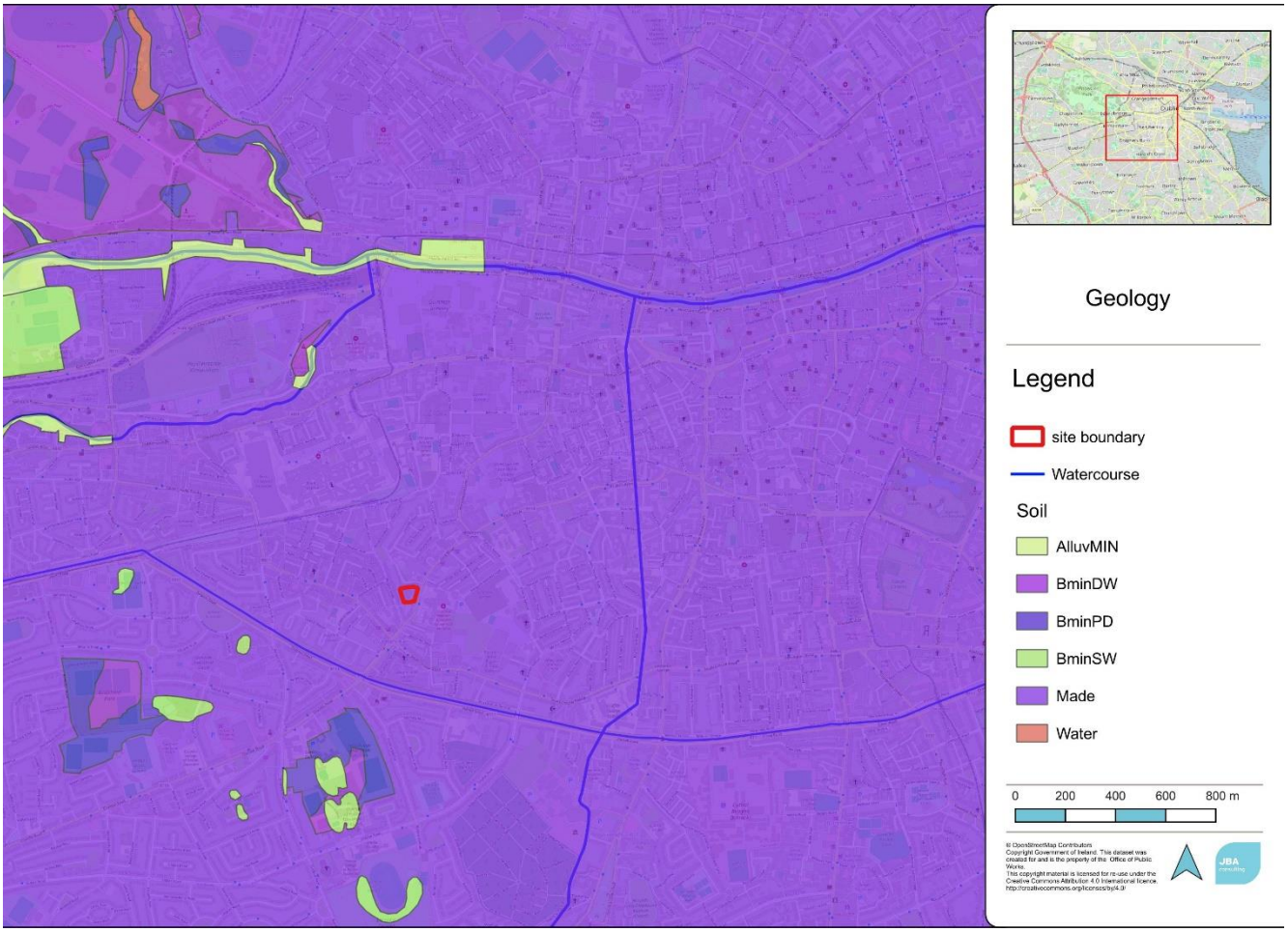


Figure 2-3: Subsoil Map

2.4 Local Groundwater Data

The GSI groundwater vulnerability maps were available for review. The groundwater vulnerability on site has been classified as `Moderate ` meaning groundwater here has moderate vulnerability to contamination by human activities. There were no areas of surface water flooding from the Winter 2015 / 2016 flood event identified on site. The Winter 2015 / 2016 Surface Water Flooding mapping shows fluvial (rivers) and pluvial (rain) floods during the Winter 2015 / 2016 flood event and was developed as a by-product of the historic groundwater flood map. There were no historic or predictive groundwater flood extents identified on site or nearby. The permeability of the subsoil overlaying the bedrock is classed as 'Low', which implies a depth to bedrock of greater than 10m.

2.5 Local Topography

LiDAR levels of the wider area are courtesy of the Geological Survey Ireland (GSI) and Office of Public Works (OPW) and show that there is a general south west to north east fall across the local area. The LiDAR data is the OPW Nasc Digital Terrain Model (DTM) which has a resolution of 2m, and an RMS error within +/- 200mm. The data was captured in 2011. The site slopes from south west to north east, with a fall of 1700 mm from 20.6mOD in the south west of the site to 18.9mOD at the north east of the site.
Further details of the local topography are shown in Table 2-1 and Figure 2-4 .

Table 2-1 Elevation Ranges for Key Areas of the Proposed Site in mOD

Location	Elevation Range (mOD)
Eastern Portion (Entrance along Dolphin's Barn Street)	18.9 - 19.2
Western Boundary (Rear garden boundaries on Reuben Street)	19.9 - 20.6
Northern Boundary (Rear garden boundaries on Emerald Square)	19.1 - 19.9
Southern Portion of the Site	19.1 - 20.6
Central Portion of the Site	19.7 - 19.8

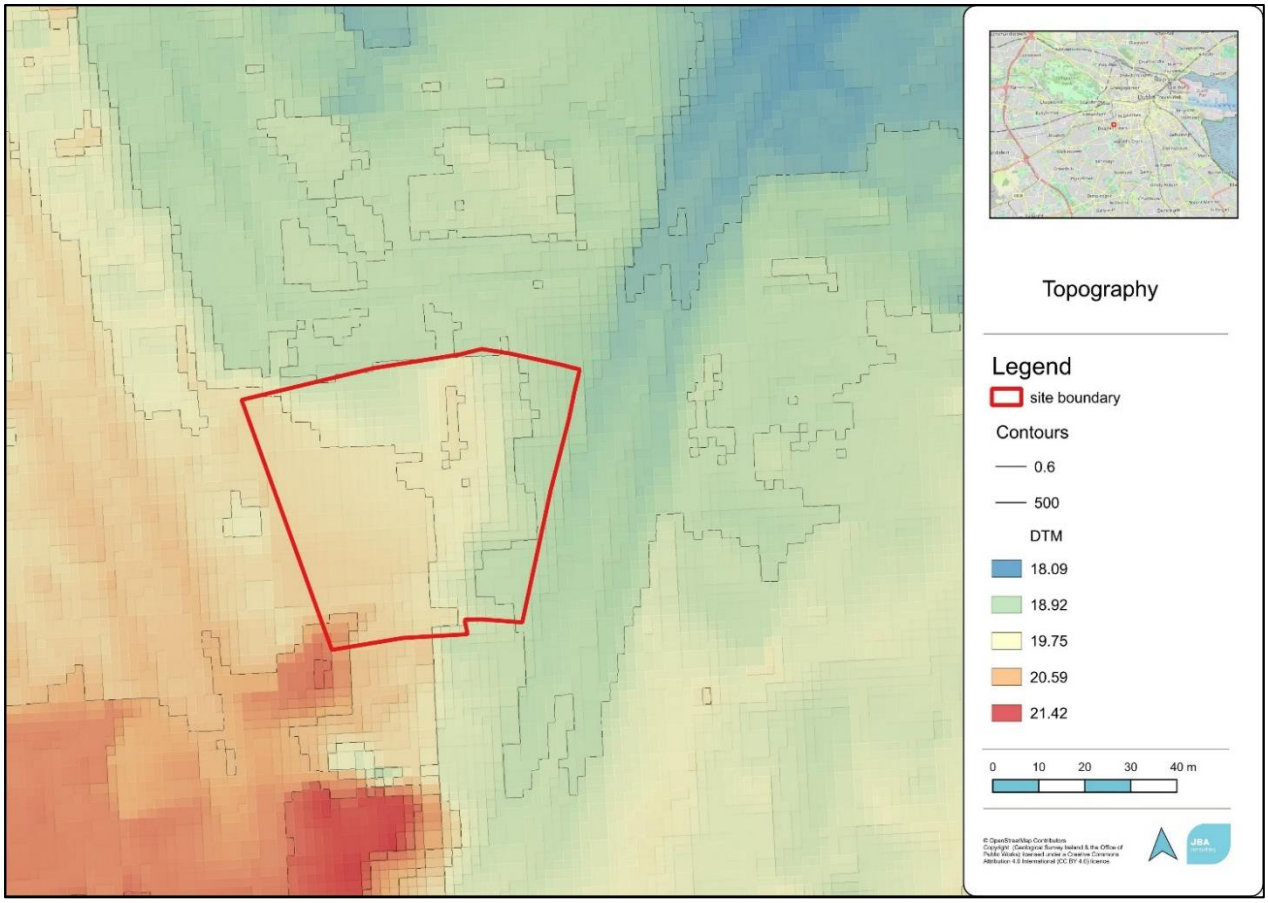


Figure 2-4: Local Topography

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historical flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information have been reviewed to establish any recorded flood history at, or near the site. This includes the OPWs national flood information portal, www.floodinfo.ie, and general internet searches.

3.1.1 Floodinfo.ie

The OPW have established a National Flood Risk Hazard Mapping website, www.floodinfo.ie, which highlights areas at flood risk through the collection of recorded data and observed flood events.
The website provides comprehensive national data detailing a historical event in the vicinity of the proposed site:

- Flood ID-661: Flooding occurred on January 20, 1941. The River Poddle overflowed at Marrowbone Lane due to a partial diversion into the sewer system. Inadequate flow restriction at Donore Avenue led to an increased flood risk, highlighting the need for stringent watercourse management and urban planning measures. approximately 800m north east of the subject site location.
- Flood ID-287: Flooding occurred on 10 June, 1963. approximately 1km east. The source of flooding fluvial.
- Flood ID-11961: The flooding event on South Circular Road at Parnell Road, approximately 1 km southeast of the subject site, occurred due to the River Poddle overtopping its banks in August 1905. This location experienced another similar flooding event in December 1986.

There are no historical records indicating any flood events at the subject site in recent times.

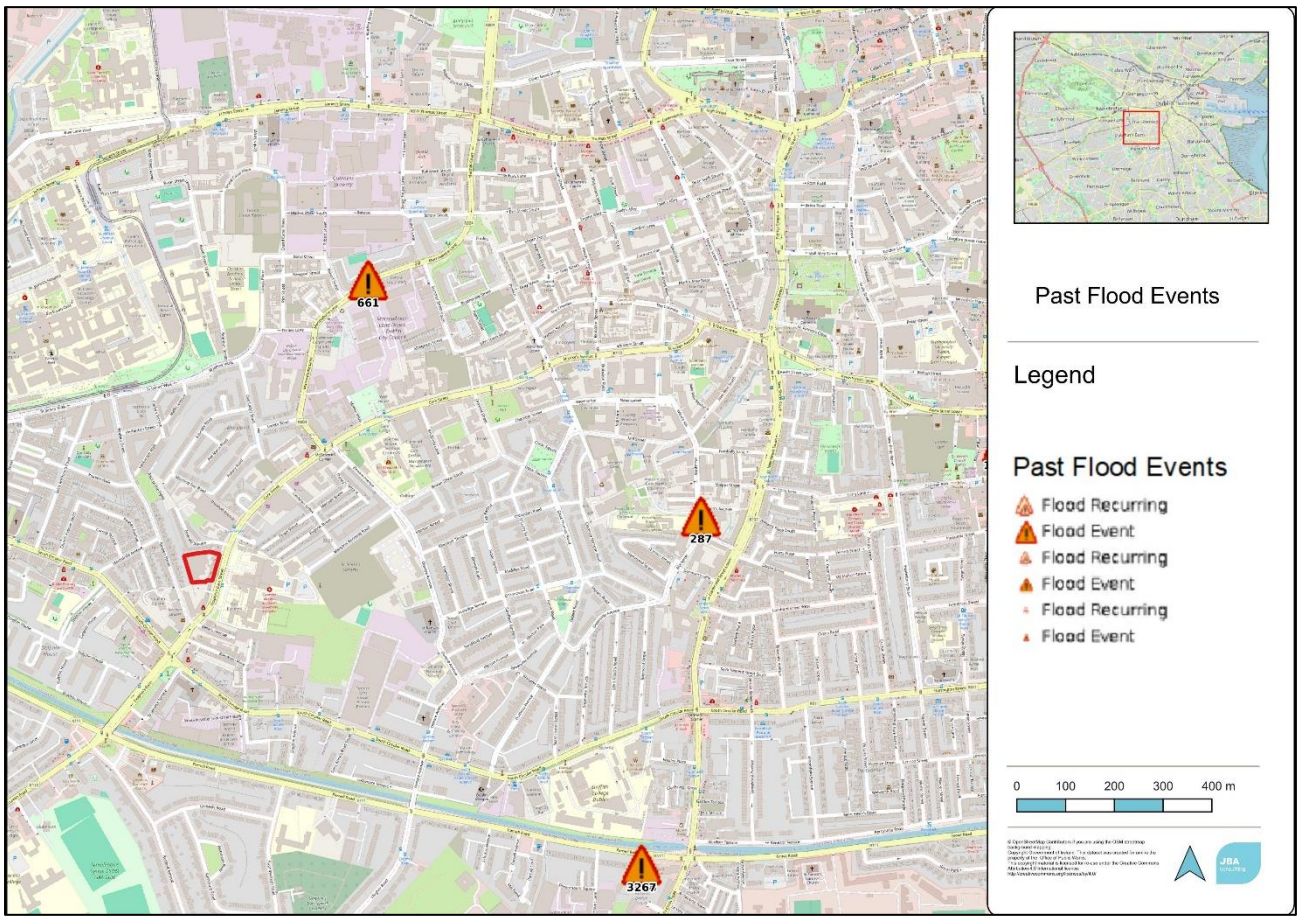


Figure 3-1: Past Flood Event Points

3.1.2 Internet Searches

An internet search was conducted to gather information about whether the site had previously been affected by flooding, and no additional incidents were reported at the site beyond those already documented in the previous section 3.1.1.

3.2 Predictive Flood Mapping

The wider area has been a subject to predictive flood mapping or modelling studies and other related studies and plans.

- Eastern Catchment Flood Risk Assessment and Management (ECFRAM) Study
- The Dublin City Development Plan 2022-2028
- The Flood ResilenCIty Project
- Poddle Flood Alleviation Scheme

3.2.1 Eastern CFRAM

The Eastern Catchment Flood Risk Assessment and Management Study (ECFRAM) commenced in 2011 and was finalised in 2016. The study involves detailed hydraulic modelling of rivers and their tributaries. Within the subject area, the CFRAM targeted areas

of significant flooding. Finalised flood maps for the 10%, 1% and 0.1% AEP are publicly available through the CFRAM Study website and floodinfo.ie. The Eastern CFRAM study is the most detailed flood mapping study to be carried out in the area. Completed in 2016, fluvial modelling was carried out on the Liffey and its tributaries.

Figure 3-2 displays an extract from the Eastern CFRAM fluvial flood maps for the area while coastal flood maps are displayed in Figure 3-3. The site is shown to be at low risk of flooding from fluvial and coastal sources.

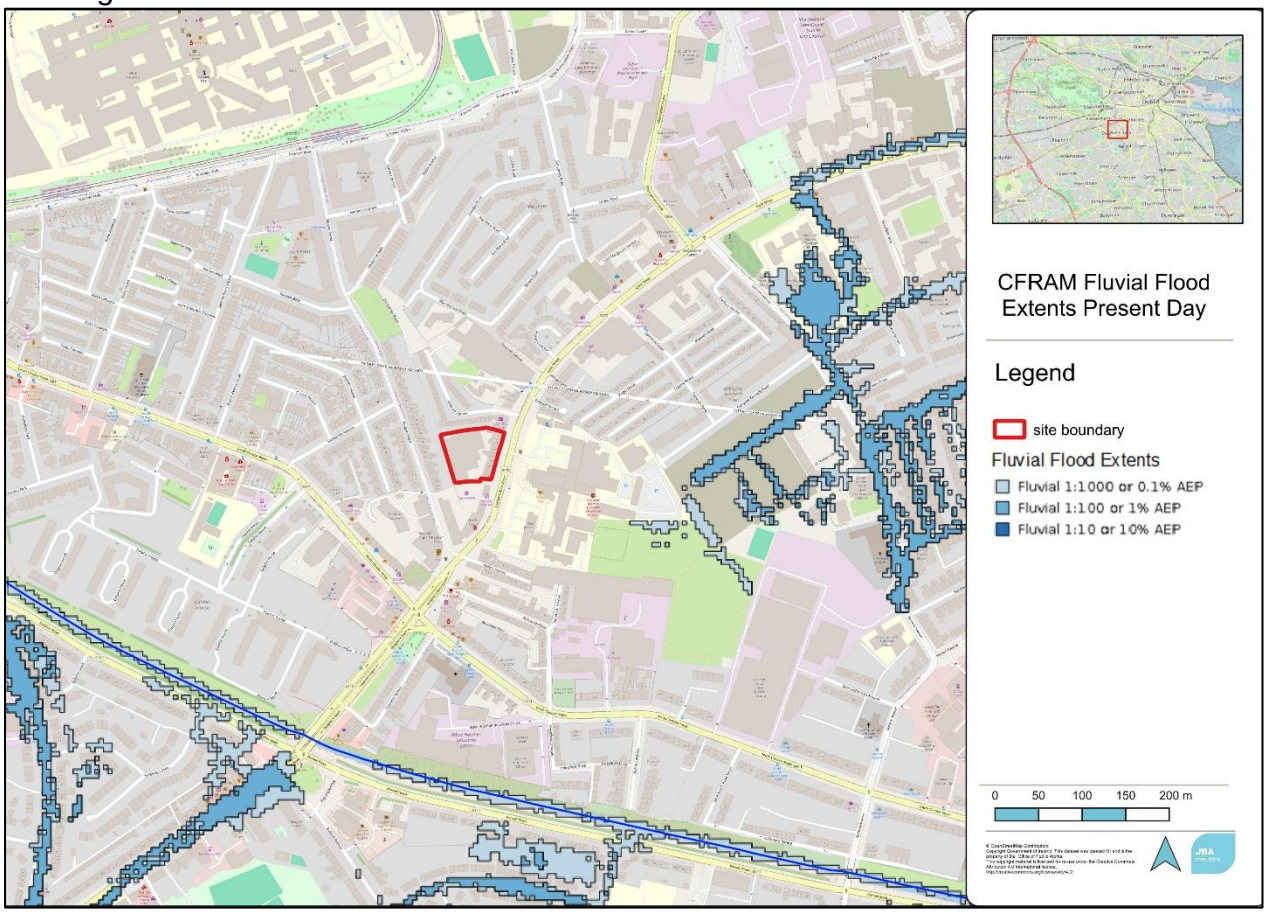


Figure 3-2: CFRAM Fluvial Flood Extents Present Day

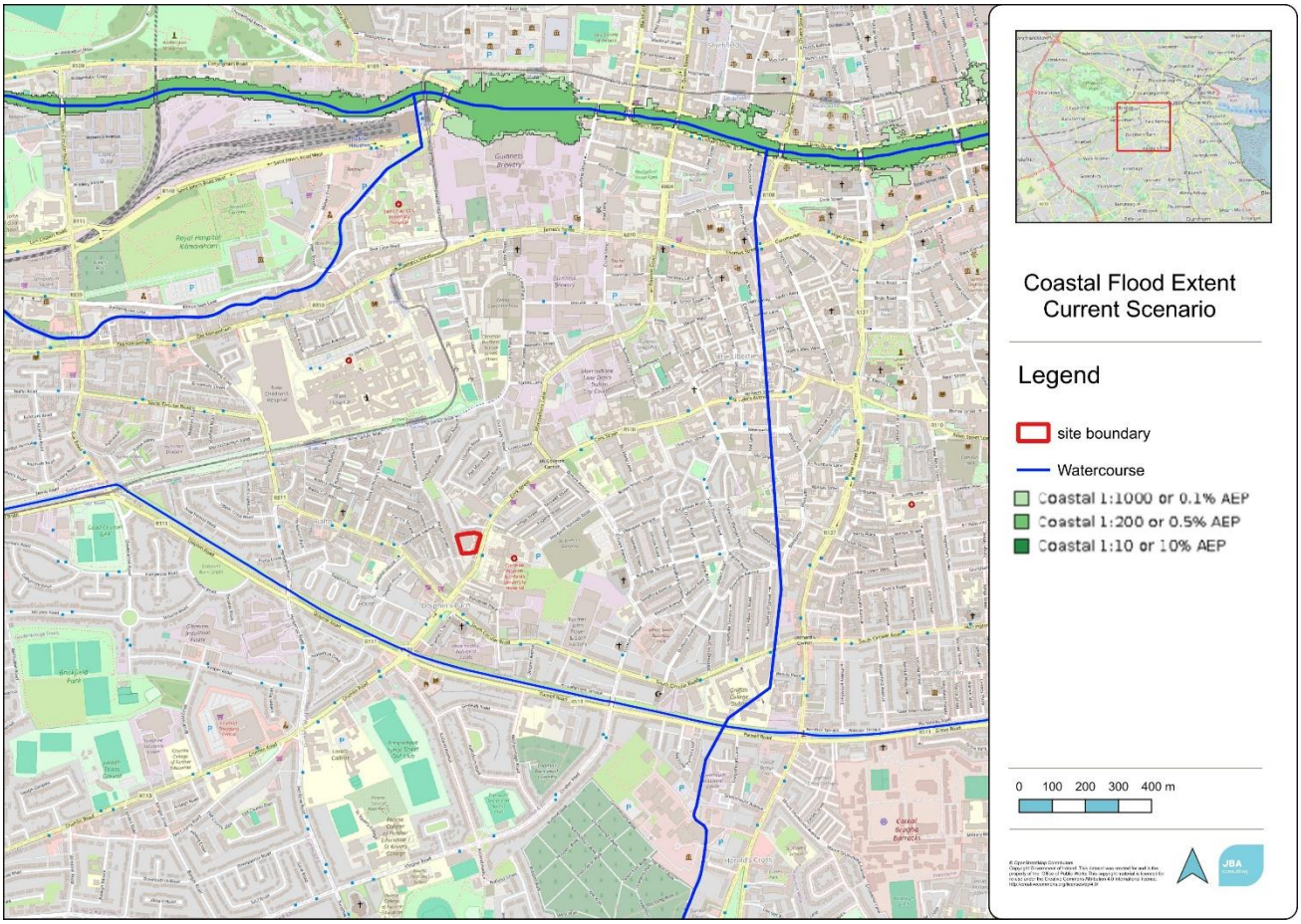


Figure 3-3: Eastern CFRAM Coastal Flood Events - Current Scenario

3.2.2 The Dublin City Development Plan 2022-2028

The Dublin City Development Plan (DCDP) has sought to proactively manage flood risk in the city in accordance with the EU Flood Directive 2007/60/EC. A Strategic Flood Risk Assessment for the DCDP 2022-2028 was carried out by JBA Consulting in accordance with the requirements of 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities' (2009). The SFRA provides an assessment of all types of flood risk within the county. Figure 3-4 depicts an excerpt of the Flood Zone Mapping for the Dolphins Barn area, with the site location in red. As can be seen from the map, the site is entirely located within Flood Zone C.(1)

(1) Dublin City Council 2022-2028. Strategic Flood Risk Assessment 2022-2028. Available at:https://consult.dublincity.ie/en/system/files/materials/5522/Volume%207%20SFRA%20Draft%20Dublin%20City%20Development%20Plan%202022-2028.pdf (Accessed 27 May 2024)

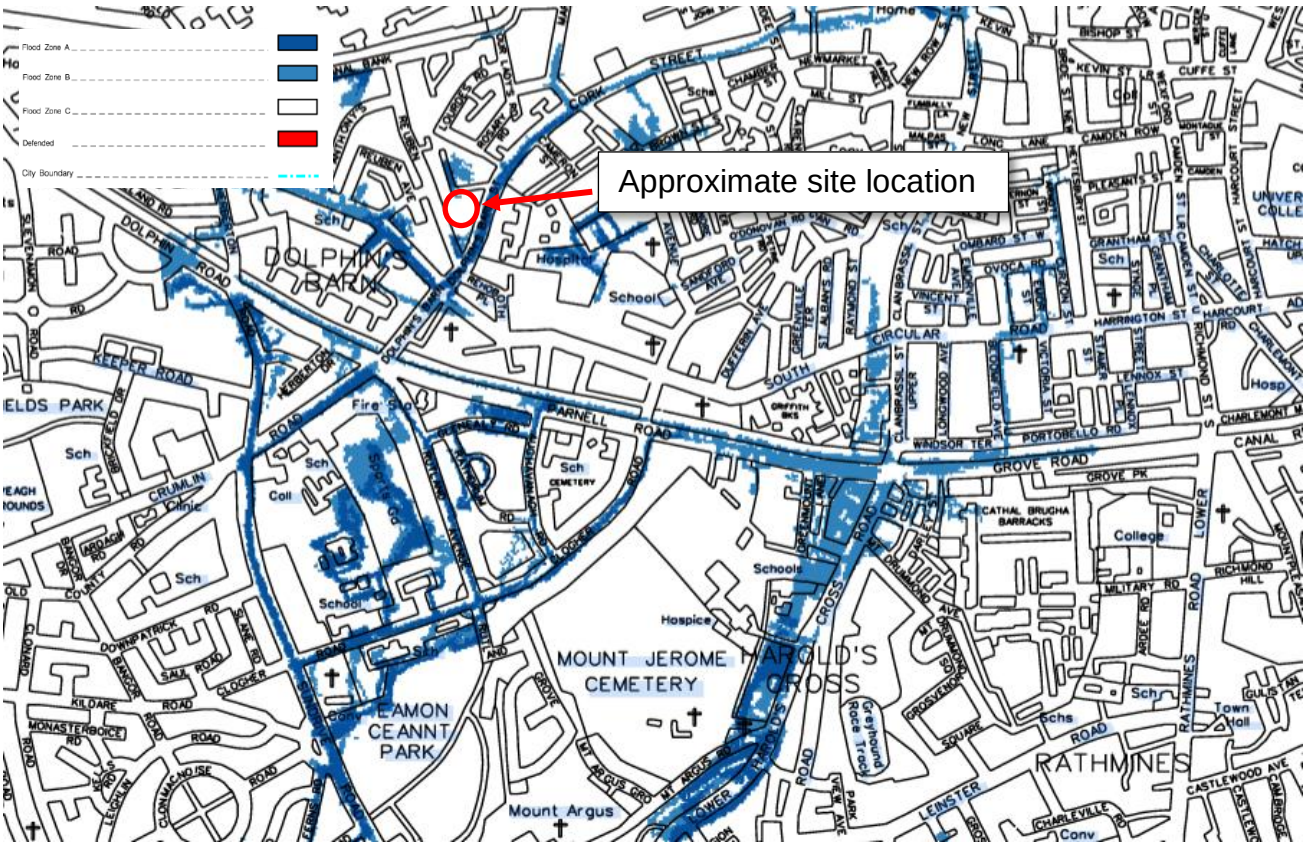


Figure 3-4: Dublin City Council Development Plan SFRA Flood Map

3.2.3 Flood ResilienCity (FRC)

Dublin City council undertook a four-year programme from 2008– 2012 to make the Dublin a flood resilient city. The FloodResilienCity project was an EU funded project supporting local authorities in eight cities in northwest Europe to combat flooding in urban areas and exchange information on best practice. It built on the previous EU-funded SAFER project, an outcome of which was the establishment of an operational coastal (tidal surge) early warning system for Dublin. The FRC project led to the development of pluvial flood hazard maps (depth and velocity maps in isolation) and flood risk maps to identify Dublin City's overall vulnerability to pluvial flood risk. An excerpt of the pluvial mapping for the site is shown in Figure 3-5. The mapping shows the site at potential risk of pluvial flooding.

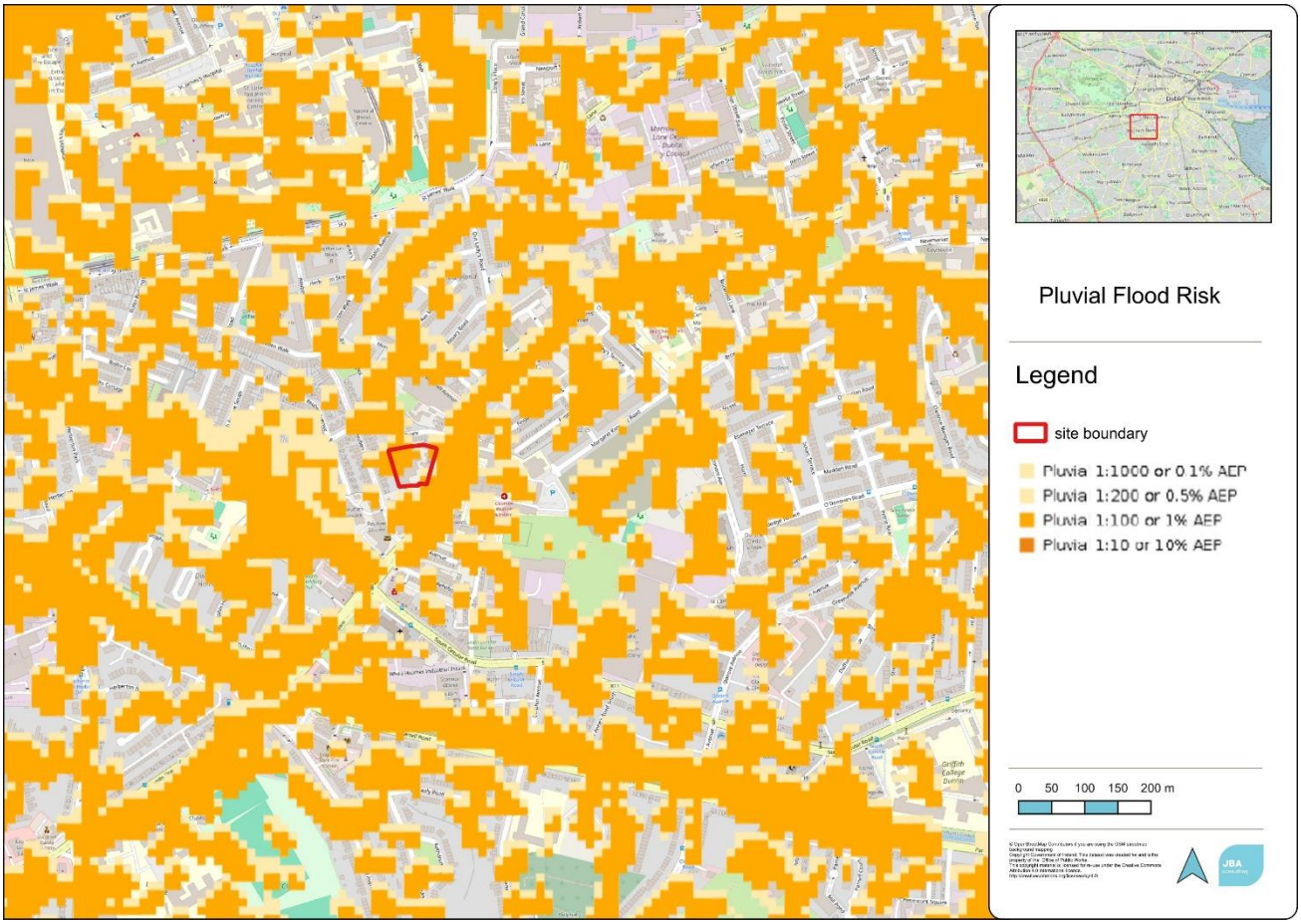


Figure 3-5: Flood ResilienCity mapping

3.2.4 Poddle flood alleviation scheme

The Scheme targets flood protection across a 6km stretch of the Poddle River, from Tymon North in Tallaght to St. Teresa's Gardens and Donore Avenue, including the National Stadium area. Key components include major flood storage facilities at Tymon Park and additional capacity at Ravensdale Park, supplemented by linear defences where necessary along the river. The design also incorporates new flap valves, culvert screens, and sealed manholes to enhance resilience against surcharging during flood events. Aimed at safeguarding against a 1 in 100-year flood event (1% Annual Exceedance Probability), the Scheme is projected to protect approximately 921 properties within the SDCC and DCC regions. Furthermore, the strategy details specific infrastructural enhancements such as a raised embankment at Tymon Park and a tri-walled storage area at Ravensdale Park to effectively manage downstream flood risks, demonstrating a comprehensive approach to urban flood mitigation[(2)]. Upon completion, the Poddle FRS will enhance fluvial flood risk mitigation in the vicinity of the proposed site.

(2)River Poddle Alleviation Scheme. ENVIRONMENTAL IMPACT ASSESSMENT REPORT VOLUME 2 – MAIN REPORT PART I – GENERAL (CHAPTERS 1-5). Available at: https://www.poddlefas.ie/_fileupload/Part%203%20Environmental%20Impact%20Assessm

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following this initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flood sources are described below.

3.3.1 Fluvial

The site is situated outside of any predicted flood extents related to Dublin's watercourses. Review of available fluvial flood mapping data categorises the site within Flood Zone C, indicating a low probability of fluvial flooding. Consequently, this source of flood risk is screened out at this stage of the assessment.

3.3.2 Coastal

The nearest CFRAM model, located 1.1 km north of the site, confirms that the area is not at risk for coastal flooding. Similar to the fluvial risk, coastal flood mapping data places the site in Flood Zone C, confirming its low susceptibility to coastal flooding. Therefore, this risk is also screened out at this stage of the assessment.

3.3.3 Pluvial

Pluvial flooding is the result of rainfall-generated overland flows which arise before run-off can enter any watercourse or sewer. It is usually associated with high intensity rainfall.

Review of historical flood event data indicates that the local area surrounding the site has no record of historic flooding. The Flood ResilienCity map was examined; however, its resolution was considered insufficiently detailed for precise flood risk assessment.

As part of the assessment of the pluvial flood risk, a comprehensive topographic analysis was undertaken to identify and assess potential hazard zones within the area.

Detailed topographic sections of the critical area and mitigation measures for potential pluvial flooding issues will be comprehensively discussed in Section 4.1 and 4.2.

3.3.4 Groundwater

Groundwater flooding results from high-sub surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. The GSI groundwater vulnerability mapping indicated a moderate risk to the groundwater at the site as well as the subsoil being of low permeability which indicates a large depth to bedrock. There is no record of historic groundwater flooding in the area. Similarly, no predictive groundwater flooding extents were identified either on-site or in the immediate vicinity. Consequently, the flood risk from groundwater sources is considered low, thereby allowing for it to be screened out of the detailed assessment.

ent%20Report/Volume%202_%20Environmental%20Impact%20Assessment%20Report/Part%20I/Part_I_Merged.pdf%20Dublin%20City%20Development%20Plan%202022-2028.pdf (Accessed 27 May 2024)

4 Flood Risk Assessment

4.1 Flood Risk

The available sources of flooding outlined in Section 3 indicate that the site may be at risk of pluvial flooding using the FloodResilienCity mapping however, topographic analyses has been conducted using LiDAR data to improve the understanding of the water flow pathway of the surrounding area.

Dolphin's Barn Street exhibits a gradual decline from 19.8 mOD to 18.6 mOD over a 250-meter stretch, facilitating surface water conveyance away from the site. Reuben Street's elevation varies from 20.3 mOD to 21.0 mOD over the initial 50 meters, then declines to 19.5 mOD before rising back to 21.0 mOD, suggesting the potential for ponding, should the drainage network fail. The profile between these streets decreases from 20.4 mOD to 18.8 mOD over 120 meters, with a potential pooling area at approximately 40 meters. Sections A-A', B-B', and C-C' collectively highlight a potential for ponding if the drainage network fails or is exceeded. Refer to Figure 4-1,Figure 4-2, Figure 4-3, Figure 4-4 below.

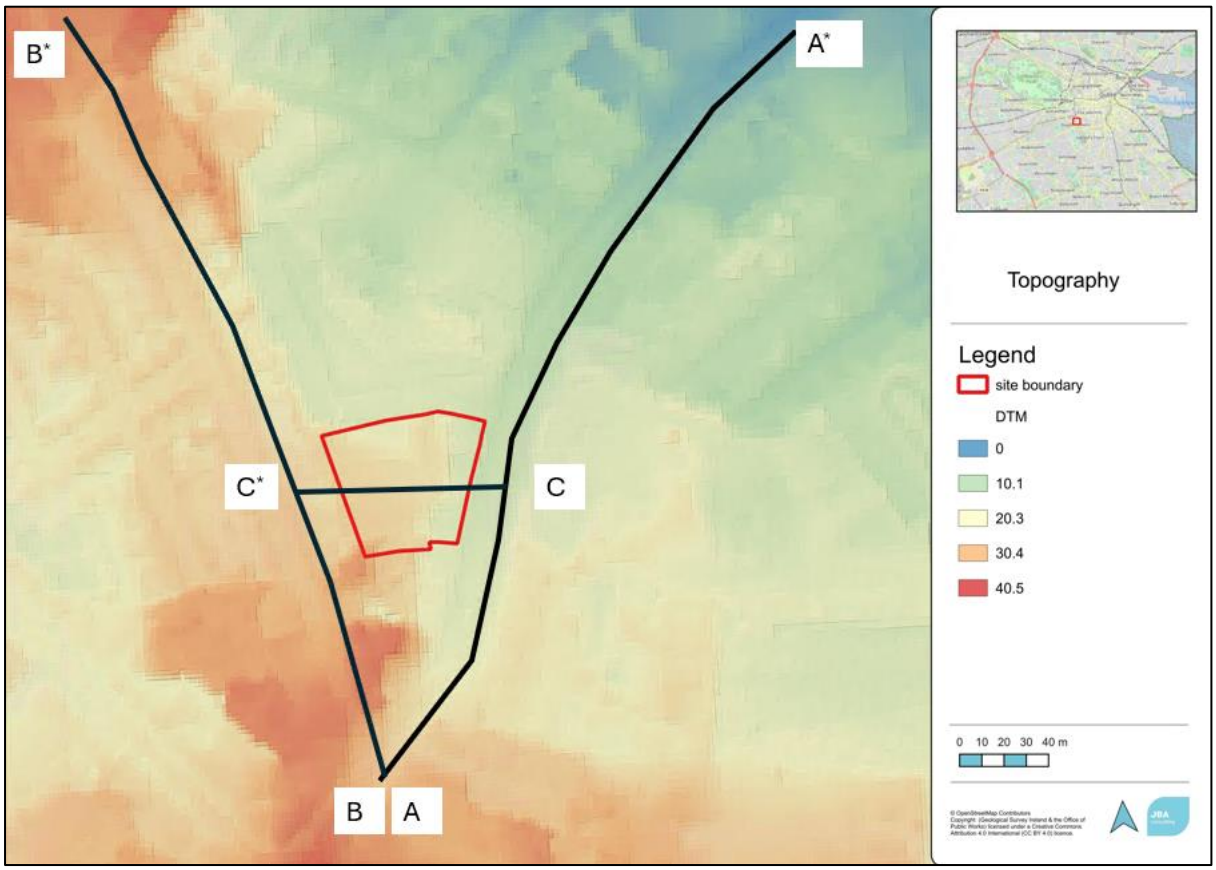


Figure 4-1: Elevation profiles A-A', B-B', C-C' across site.

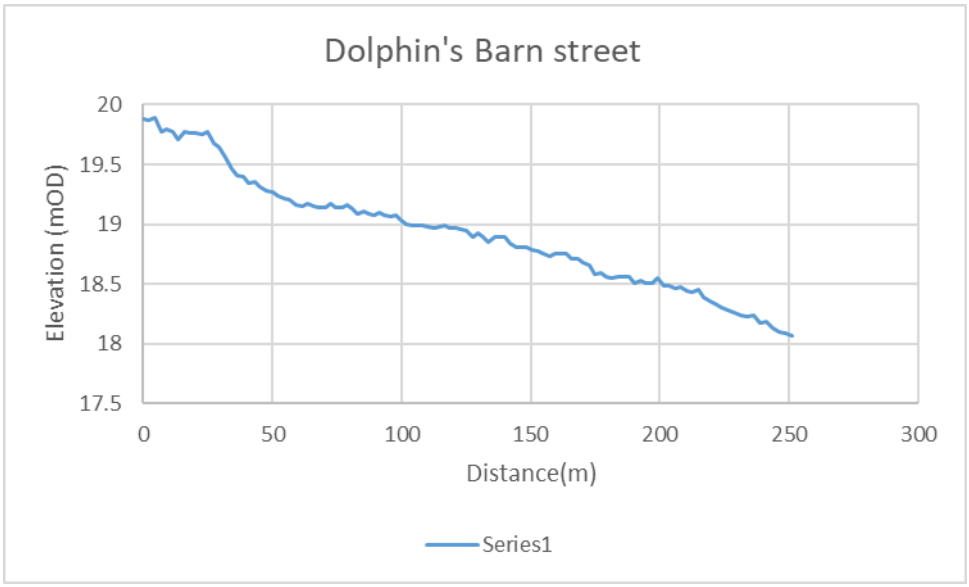


Figure 4-2: Long Section A to A*

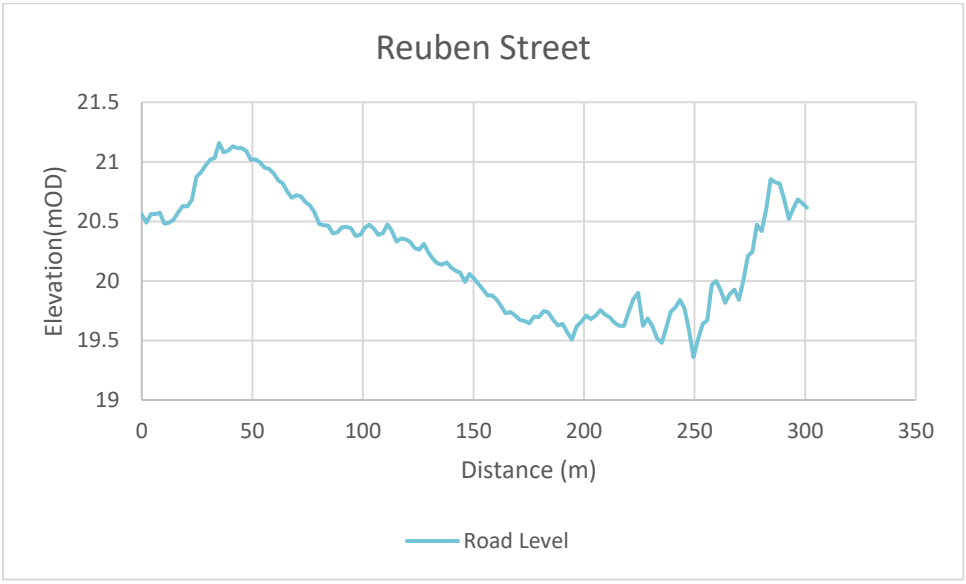


Figure 4-3: Long Section B to B*

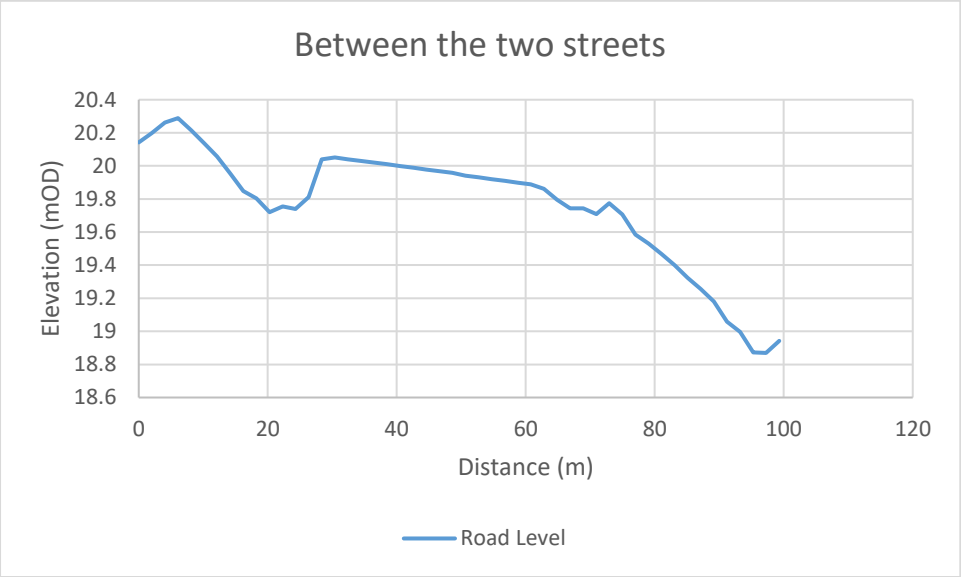


Figure 4-4: Long Section C to C*

Further mitigation options are discussed in Section 4.2.

4.2 Mitigation

4.2.1 Surface Water/Pluvial Flood Risk

The Flood ResilienCity map indicates that the site is potentially at risk of pluvial flooding for the 1% and 10% AEP events, as previously assessed in the report. However, it is crucial to emphasize that the FloodResilienCity flood mapping lacks granular topographic detail. Using LiDAR derived topographical data, a more precise delineation of hydrological flow patterns has been established. These analyses conclusively demonstrate that surface water runoff is systematically channelled away from the proposed development area, this will be the same under climate change scenarios with increased rainfall.

The proposed development will integrate various SuDS (Sustainable Urban Drainage Systems) components, tailored to the local environment to manage runoff at the source effectively. Specifically, at least 70% of the uppermost roof and lower terraces will consist of green and blue roofs. Additionally, all car parking spaces will feature permeable paving, and the access road will utilize porous or permeable asphalt. These installations are designed to intercept and treat the first 5 mm of rainfall. The soft landscaping throughout the site will further aid in the interception and treatment of stormwater. The plan also includes six SuDS tree pits to enhance onsite water management.

Moreover, Dublin City Council (DCC) mandates the inclusion of attenuation storage capable of containing stormwater from the Greater Dublin Strategic Drainage Study (GDSDS) Design Storm, which is a 30-year, 1-hour flood scenario. Furthermore, given the full utilization of the site for development, facilities will also be implemented to attenuate the 100-year, 6-hour flood, which necessitates a total storage capacity of 127m^3. A Hydrobrake flow control will be installed to limit the outflow to 2.0 litres per second.

For additional details, refer to the Engineering Service report JJC 2024 submitted as part of the wider planning application.

4.2.2 Finished Floor Levels

Review of the available information places the site in Flood Zone C, therefore no specific mitigation measures are required to mitigate against fluvial flood risk. It is recommended within the Dublin City Council Development Plan 2022 - 2028 that a 300mm threshold between the ground floor and the surrounding hardstanding area is provided to protect against surface water inundation.

The Finished Floor Level (FFL) at 19.07 mOD is compared with the street level of 18.860 mOD, resulting in a threshold of 210 mm. Similarly, the FFL of 19.250 mOD contrasts with a street level of 18.917 mOD, providing a freeboard of 333 mm, as indicated by the values from the survey. This freeboard is acceptable to manage stormwater exceedance risk as water will flow down from Dolphin Street towards Cork Street, following the natural gradient of the road, thereby mitigating any potential flood risk at these locations without accumulating at the entrances or the parking entrance.

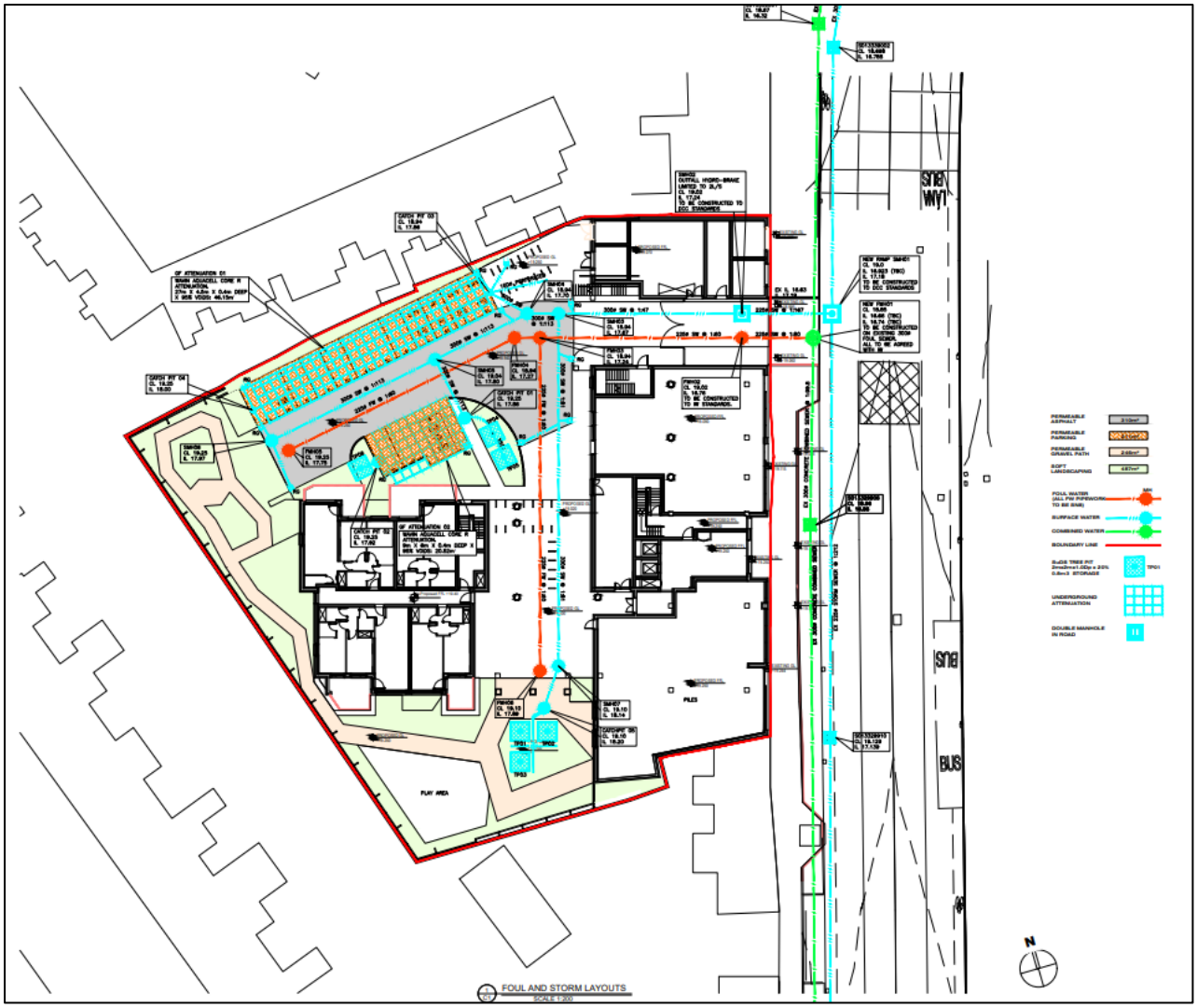


Figure 4-5: Elevation Comparison of ground levels and Bottom Kerb

4.2.3 Access and Egress

Based on the OpenStreetMap (OSM) data, properties numbered 43-50 on Dolphins Barn Street are the primary access and egress points for the proposed development site. The mentioned sites are located within Flood Zone C.

4.2.4 Climate Change

In accordance with the OPW guidelines, it is necessary to assess the risk associated with climate change, which under the medium range future scenario (MRFS) corresponds with an increase in flows of 20% for the 1% AEP flood event, or a 0.5m increase in tide levels. The site is located outside any fluvial and tidal Climate Change flood risk. The stormwater system for the site should be designed to include an allowance for climate change.

4.3 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. The flood risk assessment identifies the following as the main source of residual risk to the proposed development:

- Failure of on-site stormwater management system
- Exceedance flows (off-site) from a pluvial event

During extreme rainfall events, surcharging of the stormwater system could occur and provide a potential flood risk to the development. As discussed in Section 4.2.1, the FFL offset from road level by at least 210mm. The failure of the stormwater system is considered to have limited impact on the surrounding area due to the small size of the development, the predicted flow paths for any surface flow are away from the site, therefore no critical or sensitive development types are at risk and the overall potential impact is considered low.

5 Conclusion

JBA Consulting were requested by The Iveagh Trust to undertake a Flood Risk Assessment (FRA) for proposed residential development located in Dublin 8.

There are no historical records indicating any flood events at the subject site in recent times. The Grand Canal is the primary hydrological structure within the region. It originates from the Grand Canal Dock adjacent to the River Liffey, extends toward the River Shannon, and its course approaches the designated redevelopment area, flowing within 333 metres to the south of the proposed site at Parnell Road.

Based on review of the CFRAM flood maps, the site is classified within Flood Zone C, indicating a low risk of both fluvial and coastal flooding based on available flood mapping data, and is therefore excluded from further flood risk assessment at this stage.

Pluvial flood mapping from Flood ResilienCity revealed significant flood risks but lacked sufficient resolution. A review of the ground topography based on LiDAR data, confirms that the local topography will route surface water away from the site.

The stormwater system has been designed in accordance with the principles of Sustainable Drainage Systems (SuDS) as per the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS). An attenuation storage volume of 127m^3 has been provided with an associated discharge from the site of 2l/s.

Within the Dublin City Council Development Plan 2022 - 2028, a 300mm threshold between the ground floor levels and the surrounding hardstanding area is recommended to protect against surface water inundation. The Finished Floor Level (FFL) at different points is higher than the street level, with differences of 210 mm and 333 mm, respectively and the natural slope of the road from Dolphin Street towards Cork Street ensures water flows away, minimizing flood risks at entrances and parking areas from stormwater exceedance.

According to the Planning System and Flood Risk Management Guidelines the proposed development site is considered highly vulnerable. However, because the site is located in Flood Zone C, for both fluvial and coastal risk, it is considered appropriate, and the Justification Test is not required. Surface water flood risk and climate change impacts have also been screened out.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and is in agreement with the core principles contained within.

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship: Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table A-1: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Table A-2: Flood Zones

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.

Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

A.3 Consequence of Flooding

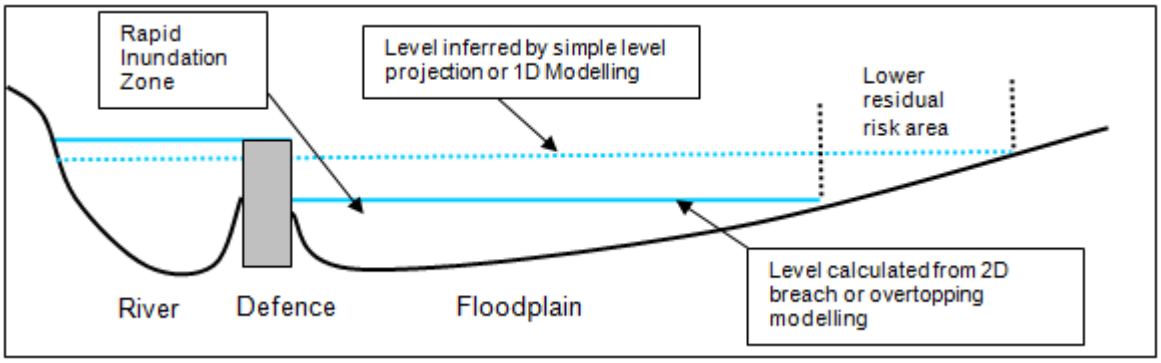
Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

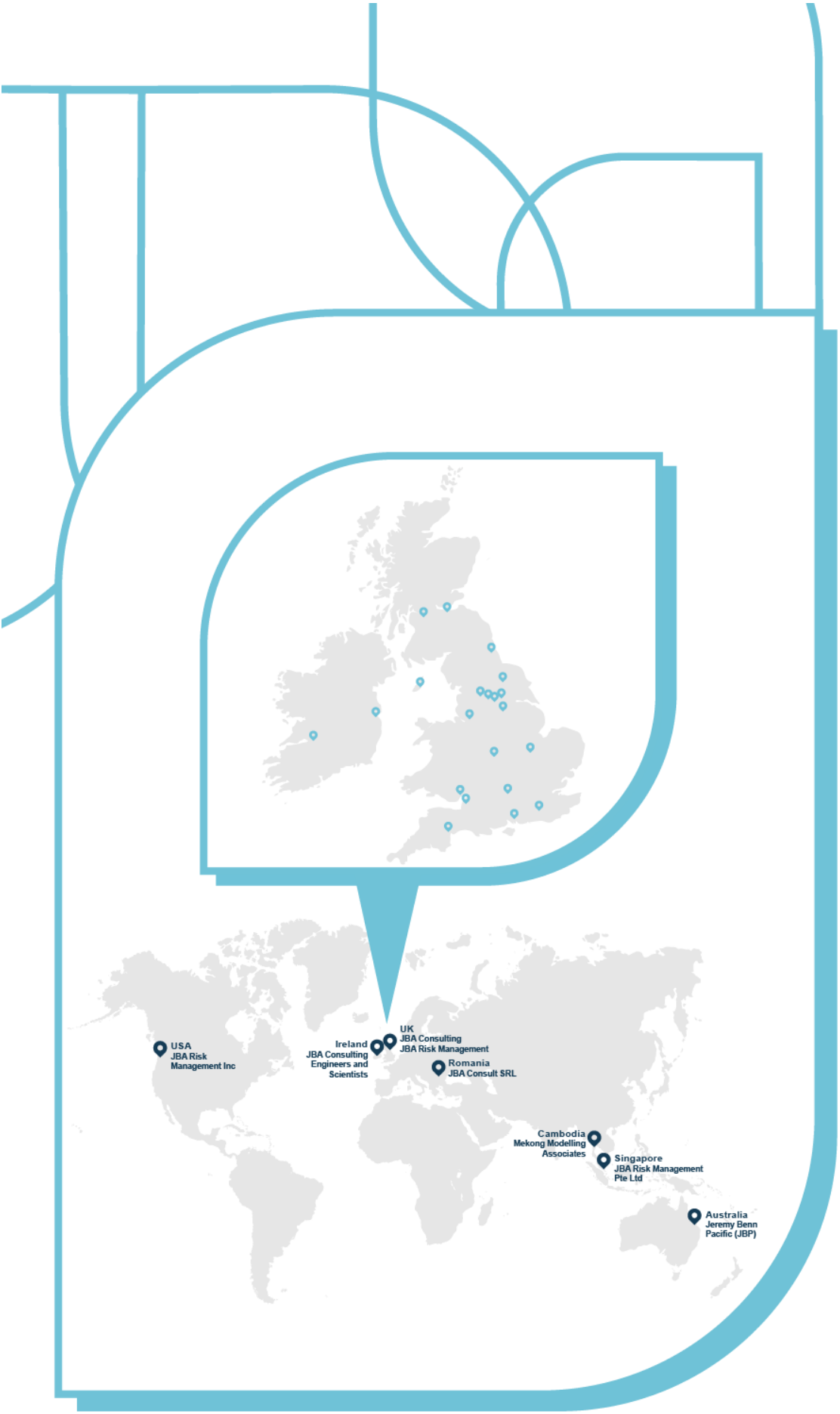
The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level, or a breach occurs. This is known as residual risk.





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