Old Knocklyon Rd Co. Dublin, Flood Risk Assessment

Final Report

January 2025

Prepared for:
McMahon Associates

www.jbaconsulting.ie

Document Status

Issue date	January 2025
Issued to	McMahon Associates
BIM reference	NZW-JBAI-XX-XX-RP-HM
Revision	S3-P04
Prepared by	Jemima Kivikoski BSc (Hons) PgD Assistant Environmental Analyst
Reviewed by	Frank O'Connell BSc MSc PgCert Senior Analyst
Authorised by	Ross Bryant BSc MSc CEnv MCIWEM C.WEM Director

Carbon Footprint

The format of this report is optimised for reading digitally in pdf format. Paper consumption produces substantial carbon emissions and other environmental impacts through the extraction, production and transportation of paper. Printing also generates emissions and impacts from the manufacture of printers and inks and from the energy used to power a printer. Please consider the environment before printing.

Contract

JBA Project Manager	Frank O'Connell
Address	3rd Floor, 12 South Mall, Cork, T12 RD43
JBA Project Code	2024s1375

This report describes work commissioned by McMahon Associates, by an instruction dated 04/09/2024. Jemima Kivikoski of JBA Consulting carried out this work.

Purpose and Disclaimer

Jeremy Benn Associates Limited ("JBA") has prepared this Report for the sole use of McMahon Associates and its appointed agents in accordance with the Agreement under which our services were performed.

JBA has no liability for any use that is made of this Report except to McMahon Associates for the purposes for which it was originally commissioned and prepared.

No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by JBA. This Report cannot be relied upon by any other party without the prior and express written agreement of JBA.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by JBA has not been independently verified by JBA, unless otherwise stated in the Report.

JBA disclaims any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to JBA's attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. JBA specifically does not guarantee or warrant any estimates or projections contained in this Report.

Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where field investigations are carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in issuing this Report.

Copyright

Contents

1 Introduction 1

1.1 Terms of Reference 1
1.2 Flood Risk Assessment Aims and Objectives 1
1.3 Proposed Development 2
1.4 Report Overview 2

2 Site Background 3

2.1 Location 3
2.2 Watercourses 4
2.3 Site Geology 4
2.4 Local Topography 5

3 Flood Risk Identification 7

3.1 Flood History 7
3.2 Predictive Flood Mapping 9
3.3 Sources of Flooding 12

4 Detailed Flood Risk Assessment 13

4.1 Hydrology 13
4.2 Hydraulic Model 15

5 Flood Risk Assessment and Mitigation 18

5.1 Flood Risk 18
5.2 Mitigation 18
5.3 Residual Risks 21
5.4 Climate Change 22

6 Conclusion 23

A Understanding Flood Risk 24

A.1 Probability of Flooding 24
A.2 Flood Zones 24
A.3 Consequence of Flooding 25
A.4 Residual Risk 26

List of Figures

Figure 1-1: Development Proposal 2
Figure 2-1: Site Location and Watercourses 3
Figure 2-2: Quaternary Sediments Map 5
Figure 2-3: Local Topography 6
Figure 3-1: Past flood events within the vicinity of the development site 8
Figure 3-2: Blocked trash screen at Ballycullen culvert causing flooding in 2011 (Flood ID-11686) 9
Figure 3-3: CFRAM Fluvial Flood Extents - Current Scenario 10
Figure 3-4: South Dublin County Council Development Plan SFRA Flood Map 11
Figure 4-1: Contributing catchment area 14
Figure 4-2: Flood Zone map 16
Figure 4-3: Flow conveyance between Ballycullen Stream culverts 17
Figure 5-1: Water levels and design FFLs and freeboard 19
Figure 5-2: Culvert blockage flood extent 21
Figure 5-3: Climate change flood extents 22

List of Tables

Table 4-1: Catchment descriptors for selected HEPs 13
Table 4-2: Flow estimation results for the Upstream HEP 14
Table 5-1: Maximum water levels, FFLs and associated freeboard 20
Table A-1: Conversion between return periods and annual exceedance probabilities 24
Table A-2: Flood Zones 24

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
FAS	Flood Alleviation Scheme
FB	Freeboard
FFL	Finish Floor Levels
FRA	Flood Risk Assessment
FSR	Flood Studies Report
GDSDS	Great Dublin Sustainable Drainage Strategy
GSI	Geological Survey of Ireland
LiDAR	Light Detection and Ranging
OPW	Office of Public Works
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 a residential development located on along Old Knocklyon Rd in South Co. Dublin.

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 Proposed Development

The proposed development consists of 29 no. housing units at Castlefield Avenue. The proposed site layout is displayed in Figure 1-1.

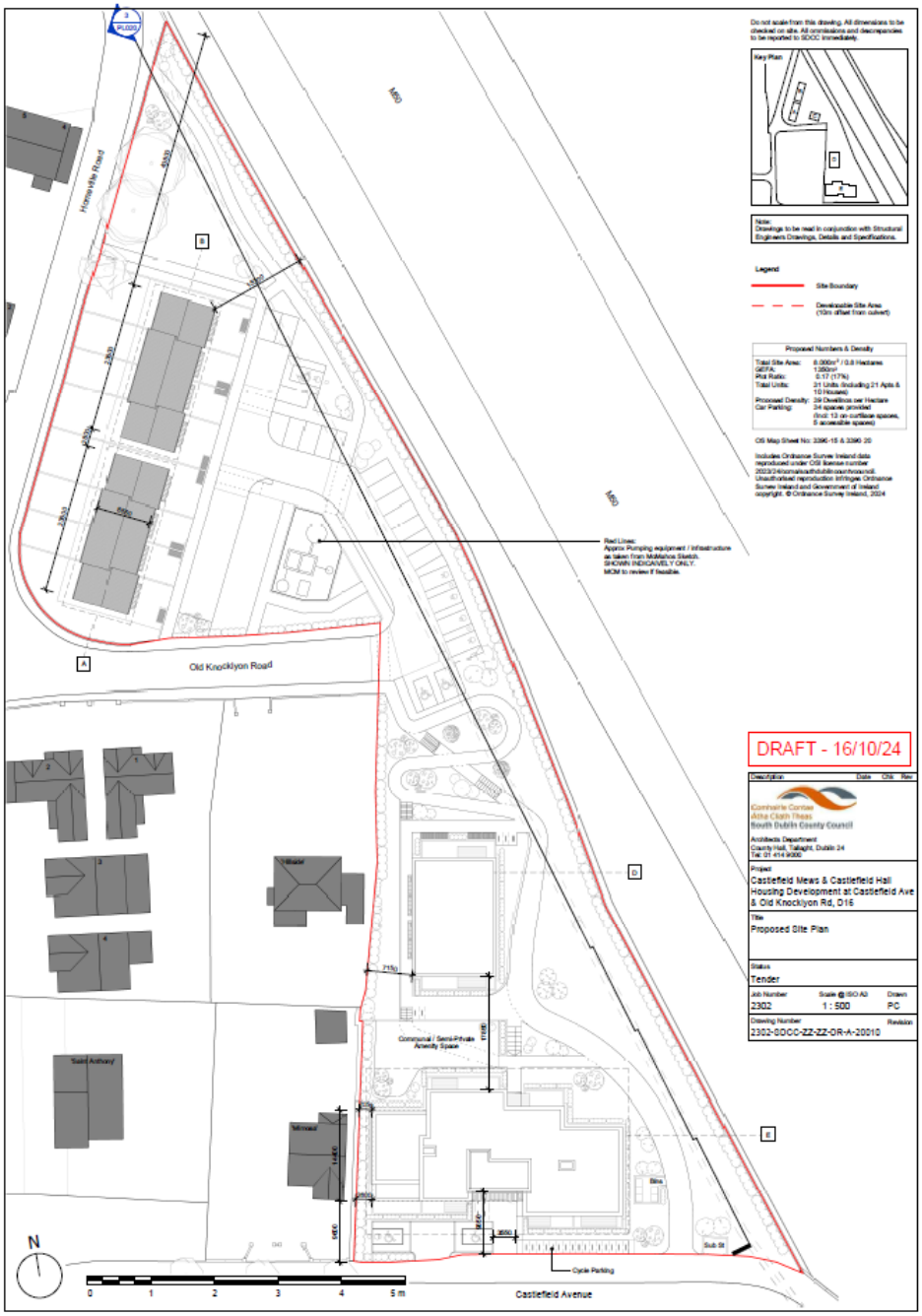


Figure 1-1: Development Proposal

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 an overview of the hydraulic model and Flood Zones. Section 5 discusses flood risk and mitigation measures. Conclusions are provided in Section 6.

2 Site Background

This section describes the receiving environment of the proposed development site in terms of watercourses, geology, and characteristics of the wider geographical area.

2.1 Location

The proposed development site is located in the area of Knocklyon, a southwestern suburb of Dublin City. The M50 lies directly adjacent to the eastern boundary of the site.

The Dodder River is approximately 350m to the north of the site and the Ballycullen stream is culverted under the surrounding urban fabric to the south. A small section of the stream remains open channel. This open channel is within 50m of the site to the northwest.

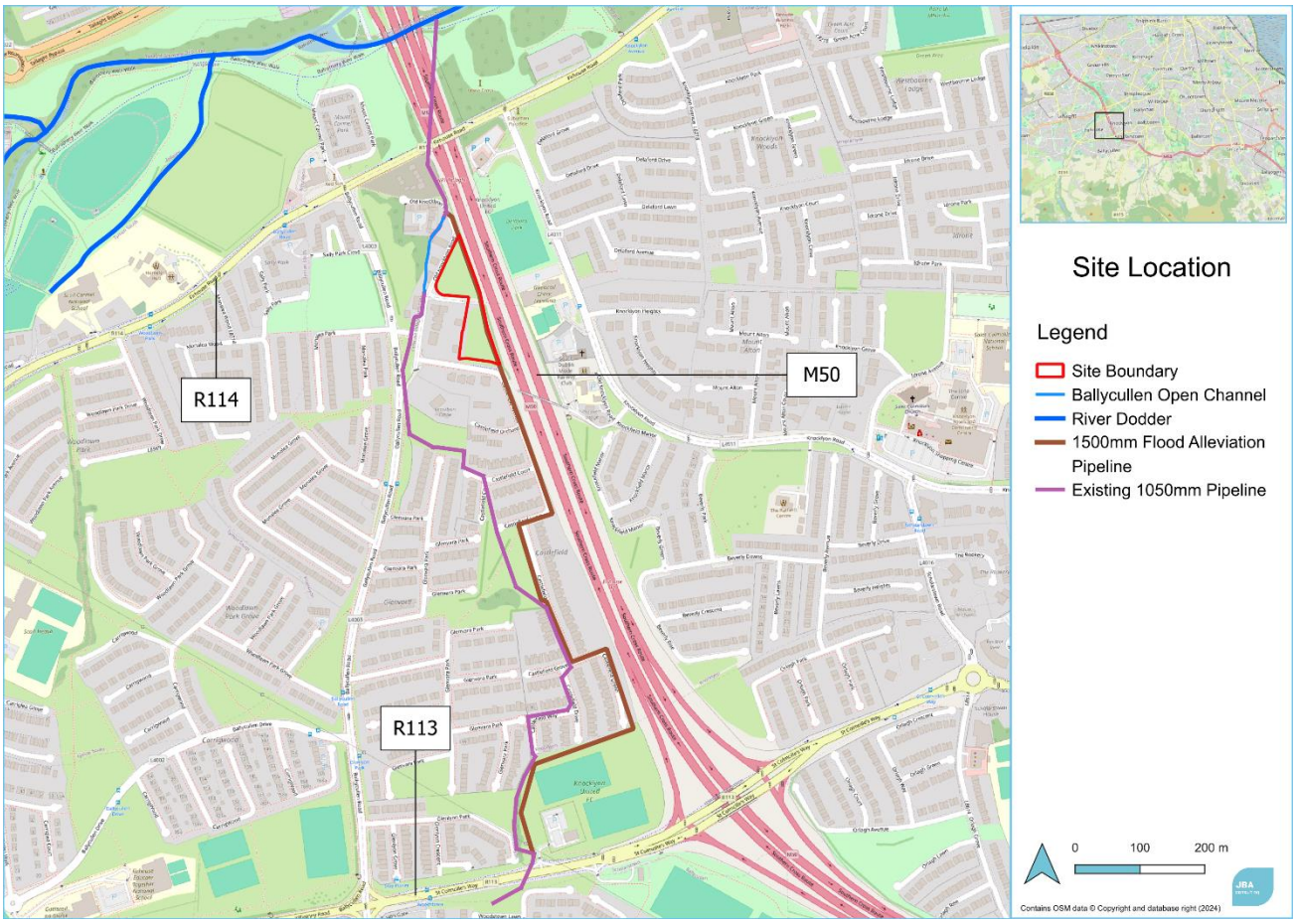


Figure 2-1: Site Location and Watercourses

2.2 Watercourses

The site is within the Liffey and Dublin Bay catchment and the Dodder sub-catchment (Dodder_SC_010). The site is contained within the Dodder_040 river basin and the primary watercourse in the vicinity of the site is the Ballycullen Stream.

The stream is a heavily modified waterbody, first realigned as part of the M50 construction and subsequently culverted to allow for the construction of Castlefield properties. Most of the stream is culverted apart from a small section of open channel to the west of the proposed development site.

In response to flooding in the Ballycullen area in October 2011, the Ballycullen Flood Relief Scheme was implemented in October 2017. The scheme involved the installation of a new 1500mm diameter pipe to alleviate pressure on the existing 1050mm pipe system. Further information on the scheme can be found in Section 3.2.3.

2.3 Site Geology

Groundwater and geological data provided by the Geological Survey of Ireland (GSI) have been studied across the site and surrounding area. The bedrock underlying the site is Calp comprised of dark grey to black limestone and shale. The subsoil underlying the site is predominantly till and gravels derived from limestones with areas of made ground lying on either side. Topsoil across the site is classified as urban.

2.3.1 Groundwater

The site is within the Dublin groundwater body. The aquifer associated with Calp is classified as a locally important aquifer moderately productive only in local zones.

Groundwater vulnerability is low in the northern part of the site and low in the southern. Flows in the Dublin groundwater body trend towards the coast with an estimated general transmissivity of 1-10m^2/day. Most groundwater flow is likely to occur close to the surface[1].

[1] Dublin GWB: Initial Characterisation, Geological Survey Ireland

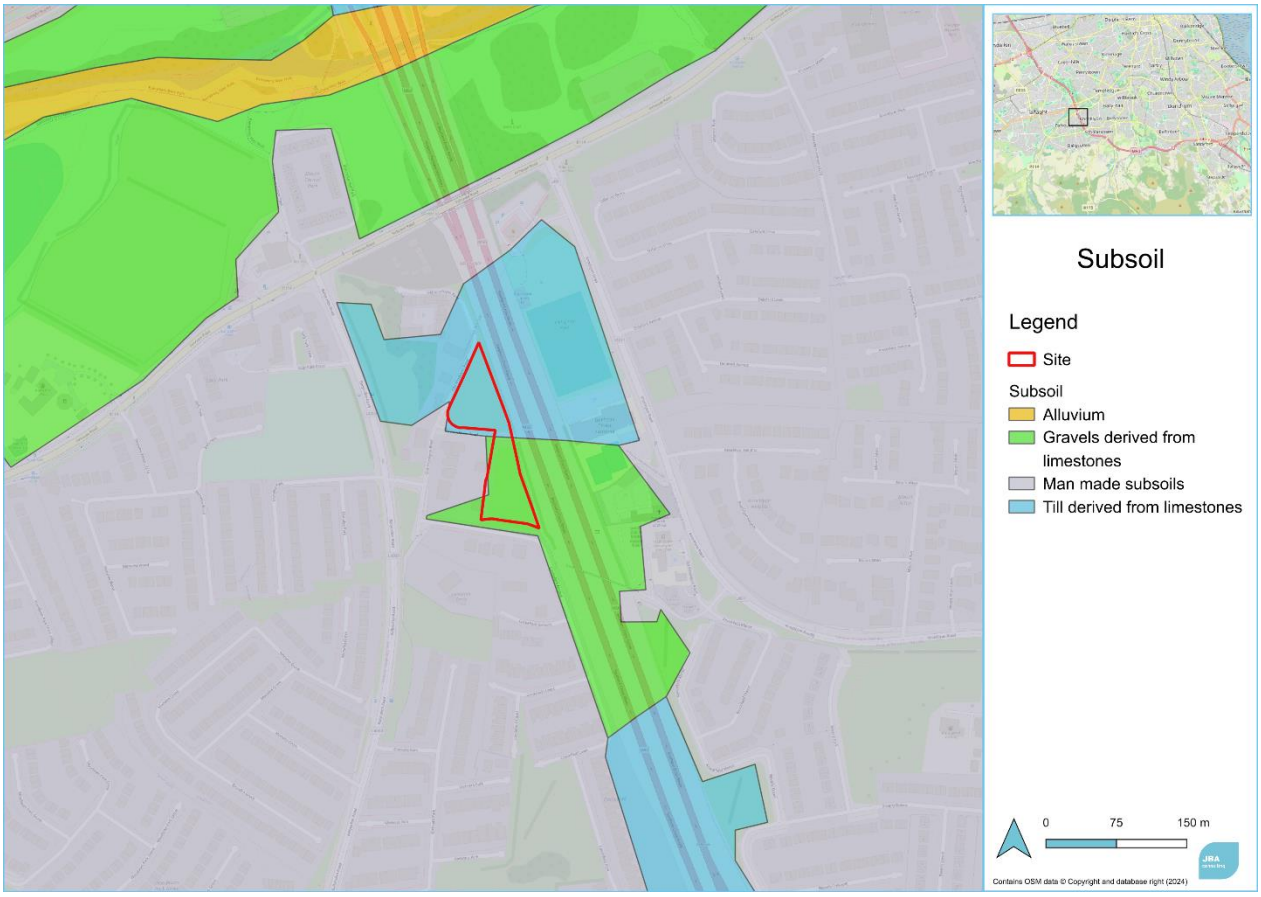


Figure 2-2: Quaternary Sediments Map

2.4 Local Topography

The site is approximately 0.7ha. 2m resolution LiDAR was available for the study area from the Open Topographic Data Viewer online. The LiDAR extent is shown in Figure 2-3 and covers the entire model area. The LiDAR was collected in 2011 by FUGRO-BKS. The resolution of the LiDAR is 2m and has an RMS within +/- 150mm. The LiDAR shows that the site slopes from south to north with maximum and minimum elevations of 80.01 mAOD and 71.5 mAOD, respectively. In addition to available LiDAR, a topographic survey was undertaken in November 2024 by Murphys Geospatial to provide spot levels of several walls adjacent to the stream, the open channel and associated structure dimensions, and nearby ground levels.

The topography of the site and surrounding area gently slopes generally towards the Dodder.

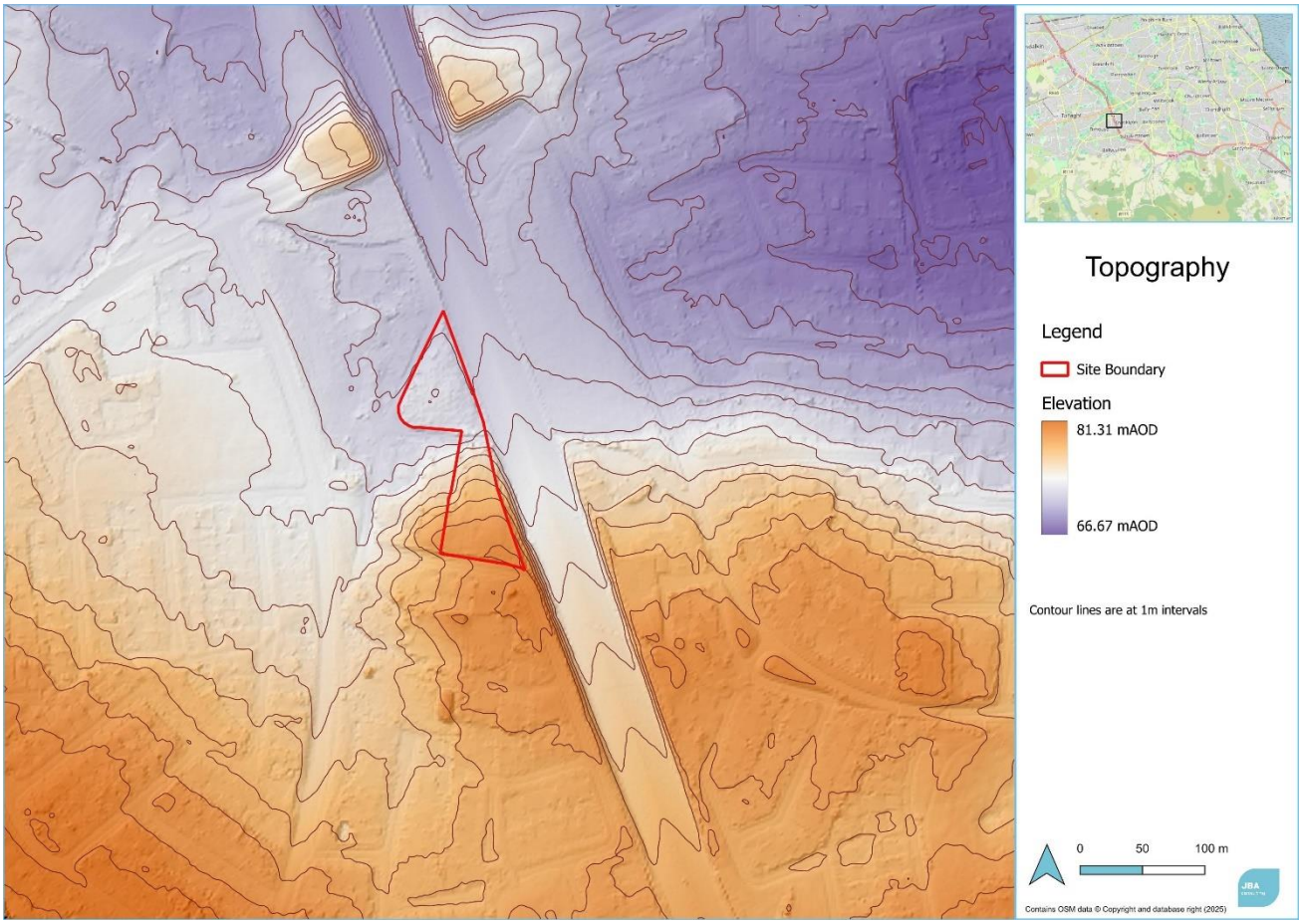


Figure 2-3: Local Topography

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 significant national data and indicates there are multiple reports of flooding along Ballycullen Steam and the Dodder. Residents have reported varying issues with flooding following modifications to the stream during the construction of the M50 and Castlefield residential estate.

- Flood ID-2139, 03/02/1994:
  - The garden of Spawell House flooded due to an old city watercourse bursting its banks.
- Flood ID-3327, 05/11/2000:
  - Flooding occurred following a period of rainfall lasting approximately 24 hours. Exact depths for the Dodder catchment area were not provided in the report. Two Houses in Knocklyon Avenue were flooded.
- Flood ID-11684, 24/10/2011:
  - Flooding occurred from overtopping from the Ballycullen Stream. The flooding began at 6pm on the 24th with the peak flood occurring 4 hours later. The flooding ended the following morning at 6am. Water broke through 3 manholes and flow followed the gradient towards Castlefield Court and Glenvara estates. The reported depth of flood waters was approximately 500mm.
    21 properties were affected by this event.
- Flood ID-11686, 24/10/2011:
  - Flooding occurred as a result of a blocked trash screen caused water levels in the culverted Ballycullen Stream to rise. 5 no. properties and 15 people were impacted by this event.

- Flood ID-1189, 05/11/2000:
  - Flooding of homes in Mount Carmel occurred following rainfall which caused the River Poddle to burst its banks.

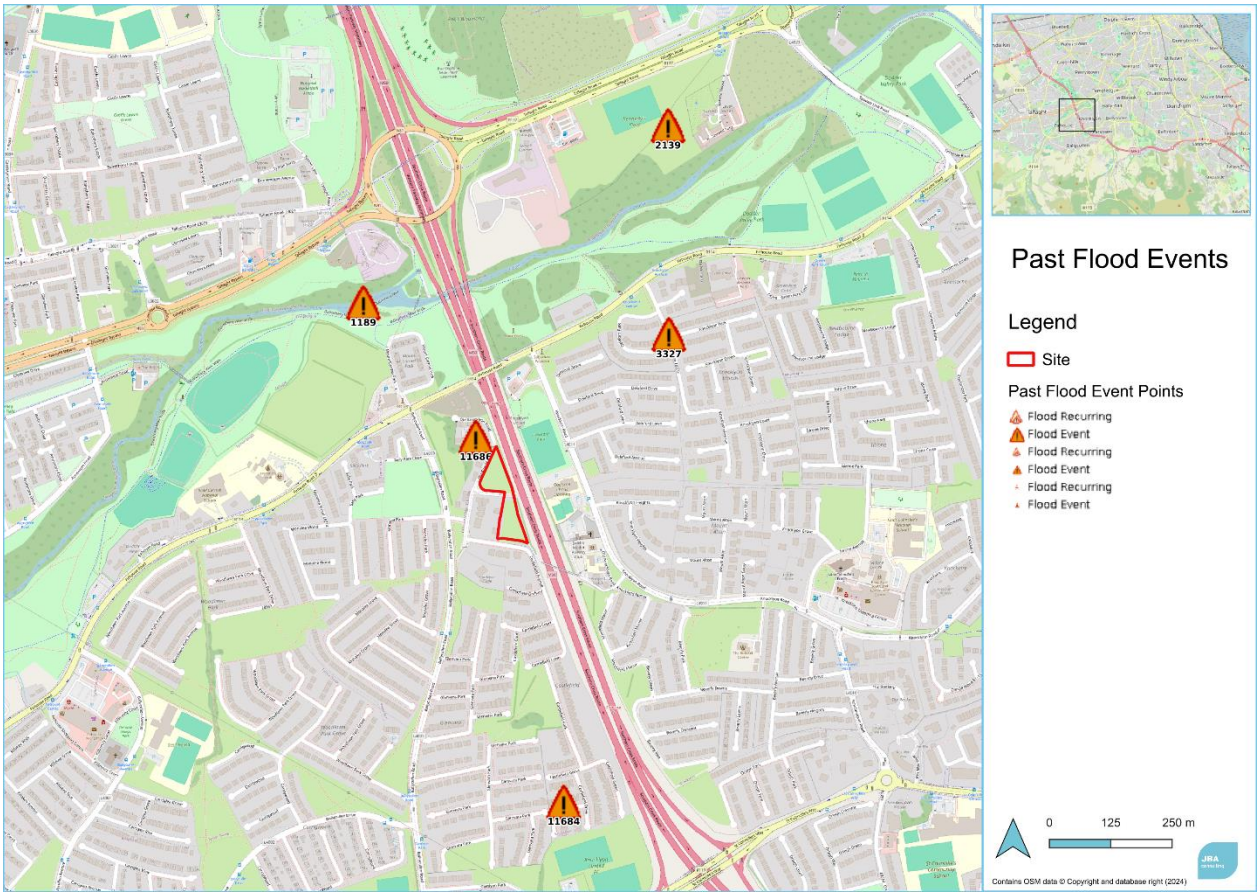


Figure 3-1: Past flood events within the vicinity of the development site

Figure 3-2: Blocked trash screen at Ballycullen culvert causing flooding in 2011 (Flood ID-11686)

3.1.2 Internet Searches

An internet search was conducted to gather additional information on reported flood events or information not recorded on official flood mapping databases. No such information was found regarding the site or surrounding areas.

3.2 Predictive Flood Mapping

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

- CFRAM.
- Strategic Flood Risk Assessment for the South County Dublin Development Plan 2022-2028.
- Ballycullen Flood Relief Scheme.

3.2.1 CFRAM

The Eastern Catchment Flood Risk Assessment and Management Study (E CFRAM) 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 extent shapefiles for the 10%, 1% and 0.1% Annual

Exceedance Probability (AEP) flood events are publicly available through the data.gov.ie website.

Flood Zone A indicates the 10% and 1% AEP events and Flood Zone B indicates the 0.1% AEP event.

The study mapped only flooding arising from the Dodder River and not the Ballycullen Stream.

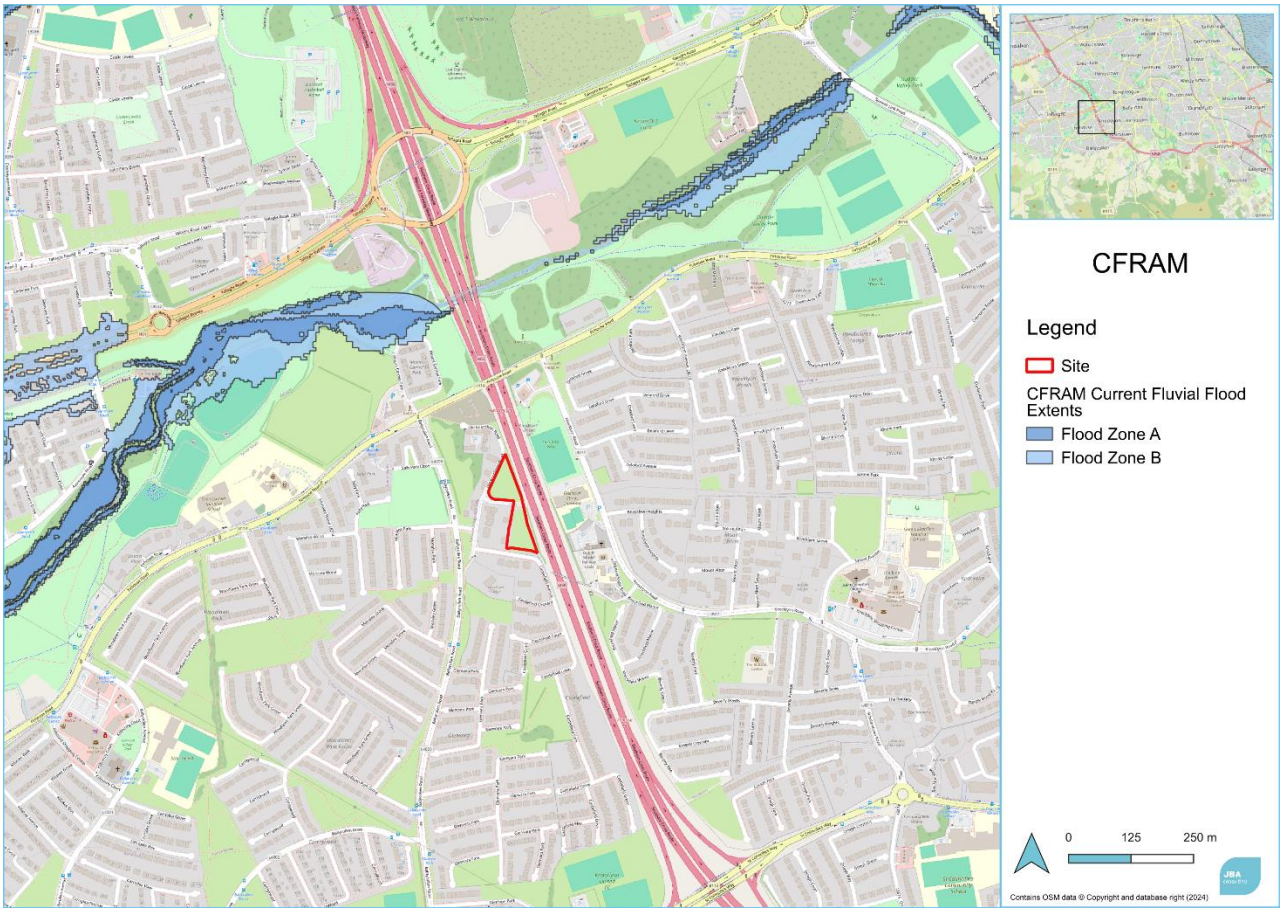


Figure 3-3: CFRAM Fluvial Flood Extents - Current Scenario

3.2.2 Strategic Flood Risk Assessment for the South County Dublin Development Plan 2022-2028

The principal guidance document for development at the site is the SDCC Development Plan. The document sets out the overall strategy for planning and sustainable development of the site, particularly in relation to flood risk.

The Council has sought to proactively manage flood risk in the county in accordance with the EU Flood Directive 2007/60/EC. A Strategic Flood Risk Assessment (SFRA) for the SDCC CDP was carried out by Roughan & O'Donovan Consulting Engineers 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 jurisdiction and informs zoning decisions and development objectives. Figure 3-4

depicts an excerpt of the Flood Zone Mapping for the Knocklyon area, with the site location marked with two X's. The site is shown to be partially within Flood Zone B. The origin of the Flood Zone mapping is the now superseded OPW PFRA mapping. The OPW no longer permit this for use due to its low confidence.

The site is zoned for the protection and/or improvement of residential amenity. It is an objective of the council under Housing Strategy Objective 18:

To ensure that where Local Authority public lands zoned Res / Res N or future zoned Res / Res N local authority lands are used to develop housing, that it is used exclusively for the delivery of social, affordable cost rental and affordable purchase homes.

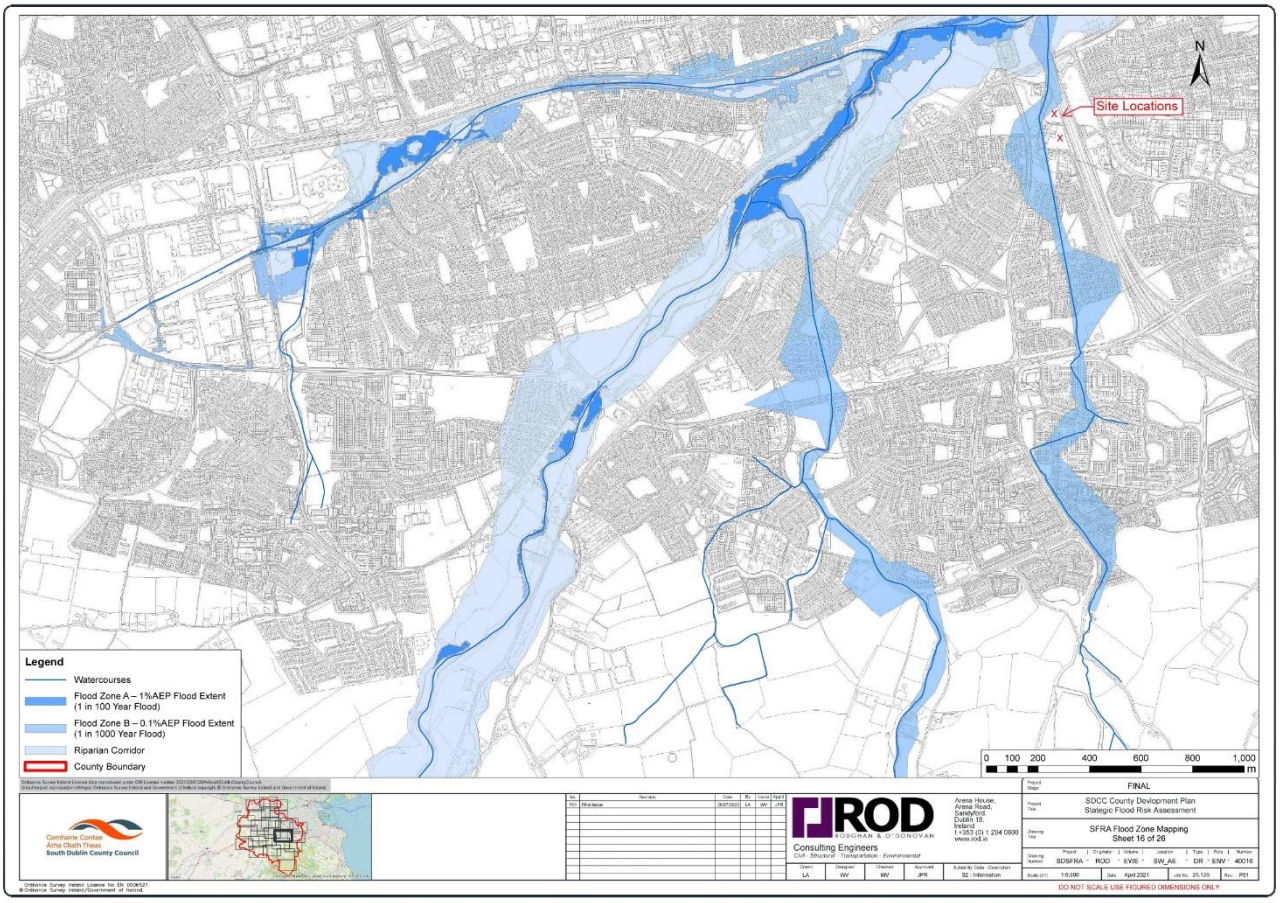


Figure 3-4: South Dublin County Council Development Plan SFRA Flood Map

3.2.3 Ballycullen Flood Alleviation Scheme

SDCC commissioned flood alleviation works for the Ballycullen Stream in response to the flooding that occurred in 2011, which damaged over 50 homes in Castle Manor. The Scheme was completed in 2017 and involved the installation of 1.5km of pipe with a diameter of 1500mm to alleviate pressure on the existing 1050mm pipe. This system splits the flow between the pipes with the new pipe taking up to 78% of flow while the remaining 22% is carried by the existing pipe. This option was chosen over flood storage measures for its minimal maintenance requirements.

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

Current data indicates that the main source of flooding, in the immediate vicinity of the site, is the Ballycullen Stream. The Ballycullen Stream is a highly modified waterbody which is historically prone to flooding as a result of culvert capacity issues and blockage. The Ballycullen Flood Relief Scheme sought to increase the capacity of the stream to prevent future overtopping. The SFRA accompanying the SDCC CDP indicates that the northern section of the site is in Flood Zone B. Based on these findings, a detailed flood model has been developed to investigate the behaviour of the Ballycullen Stream under various flow conditions and to delineate the extents of Flood Zones A and B. Details of the model are outlined in Section 4.2.

3.3.2 Pluvial

Pluvial, or surface water, flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. It is usually associated with high intensity rainfall. Flood risk from pluvial sources exists in all areas. Historically this flood source has become intertwined with the fluvial risk due to the culverting and delivery of stormwater into the fluvial system. The risk of pluvial flooding has been improved by the construction of the relief culvert and capacity increase. The detailed flood model developed for this FRA will incorporate the urban stormwater influence and is detailed in Section 4.

It is also important that increases in surface water runoff as a result of the development, including changes from greenfield to paved area, are managed.

3.3.3 Coastal

The site is inland with no transitional or tidal waterbodies in proximity. Therefore, tidal sources of flooding have been screened out.

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 low 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, there were no predictive groundwater flooding extents identified on-site or nearby.

4 Detailed Flood Risk Assessment

4.1 Hydrology

The available sources of flooding outlined in Section 3.1 indicate that the site may be at risk of fluvial flooding, arising from the Ballycullen open channel. To assist in the estimation of potential flood risk to the proposed development from the Ballycullen Stream, this section provides flow estimates for the 100-year (1% AEP) and 1000-year (0.1% AEP) events expected along the Ballycullen Stream to the northwest of the proposed development.

4.1.1 Catchment Characteristics

The physical characteristics of the catchment influence the hydrology, this includes catchment size, urbanisation, soil type, steepness, and the average rainfall. Hydrological Estimation Points (HEPs) were used to estimate river flows as no suitable gauge was nearby. Table 4-1 outlines the parameters calculated for the contributing catchments of each HEP.

Table 4-1: Catchment descriptors for selected HEPs

Descriptor	HEP_1	HEP_2
FSU Node	Upstream_boundary	Downstream_boundary
Area (km2)	1.99	2.73
SAAR1961-90 (mm)	865	845
SAAR1971-00 (mm)	757	830
SAAR1981-10 (mm)	776	823
SAAR1991-20 (mm)	809	860
Alluv	0	0
FARL	1	1
BFI Soil	0.72	0.73
URBEXT	0.28	0.42
MSL (km)	2.73	3.76
S1085 (m/km)	45.23	31.53
DrainD	1.86	1.62
ArtDrain	0	0
ArtDrain2	0	0
Soil (number)	2(100%)	2(100%)

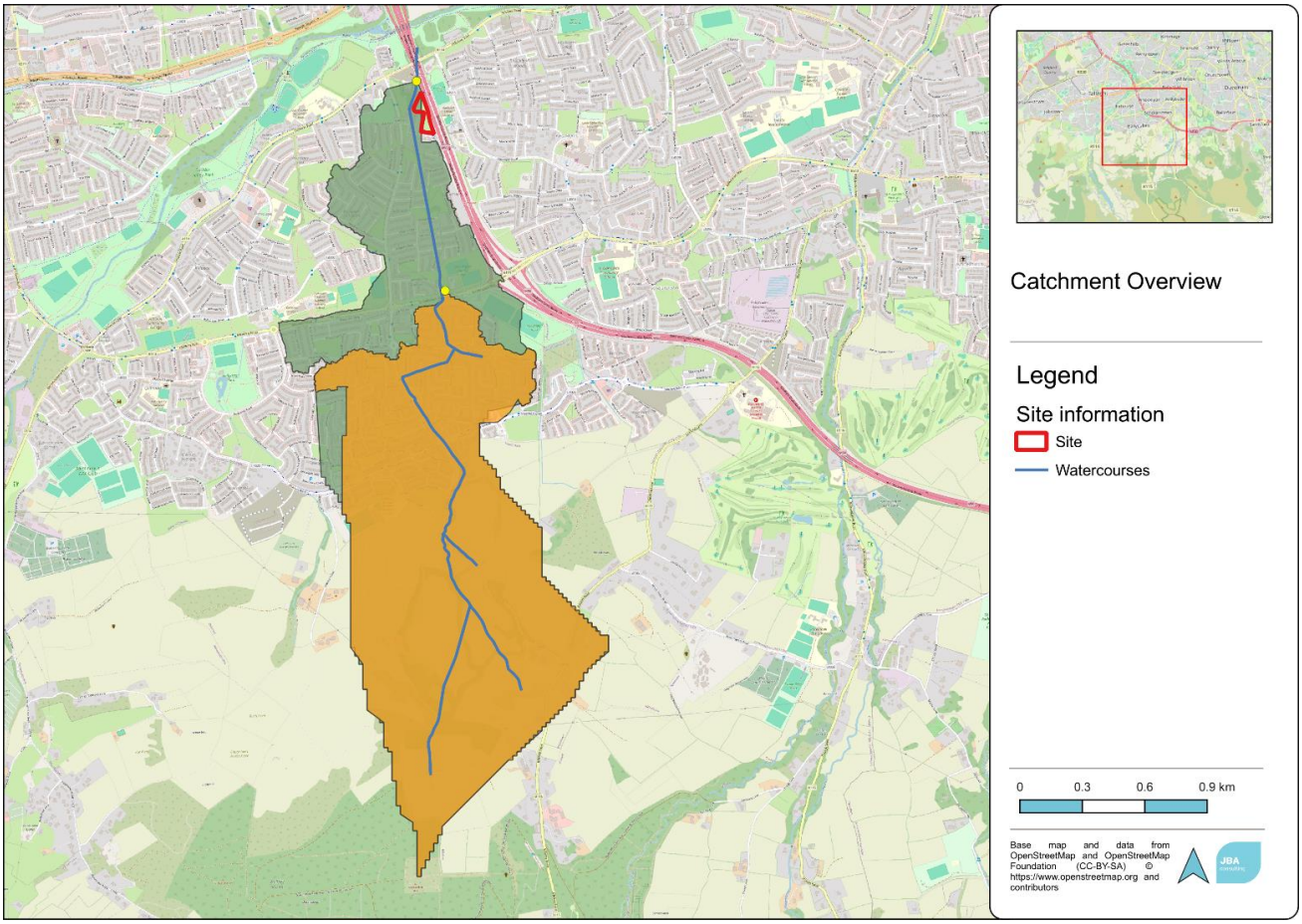


Figure 4-1: Contributing catchment area

4.1.2 Flow Estimation

Several flow estimation methods were compared under hydrological analysis. These were:

- FSR Rainfall Runoff (RR)
- Institute of Hydrology Report No. 124 (IH124)
- Rational Method

Table 4-2: Flow estimation results for the Upstream HEP

Method	Qmed (m^3/s)	1% AEP (m^3/s)	0.1% AEP (m^3/s)	MRFS (1% +20%)	HEFS (1% +30%)
FSR RR	1.04	2.86	4.44	3.43	3.72
IH124	0.35	0.72	0.96	0.86	0.94
Rational	2.15	6.48	-	7.78	8.43

Following comparison analysis, the FSR RR method was the most appropriate for representing this study as the catchment is considered flashy, has a significant proportion of urbanisation, and a short time to peak (Tp). This method generates hydrographs that

respect runoff volume and incorporates the latest Depth-Duration-Frequency (DDF) dataset, ensuring greater reliability and reduced uncertainty.

The Rational Method was discounted as it relies on a limited set of catchment descriptors. While it may be suitable for small catchments, it does not adequately represent the complexity of the study catchment or account for the variability in storm profiles and runoff processes.

4.2 Hydraulic Model

This study was modelled using a 1D-2D ESTRY-TUFLOW hydraulic model. It allows for the modelling of river channels, streams, floodplains, and hydraulic structures to predict water levels for a range of scenarios. The hydraulic model was carried out in the following stages:

- A 1D-2D ESTRY-TUFLOW model of the Ballycullen Stream network was created using survey data and flood alleviation scheme data. The network is primarily culverts with a small section of open channel.
- Three structures occur along the section of open channel to the northwest of the proposed development site, which are two culverts and a road bridge.
- Hydraulic simulations were run to derive the existing flood extent to determine Flood Zones A, B, and C at the site.
- Hydraulic simulations to account for climate change, under the Medium Range Future Scenario (MRFS) (1% AEP + 20%) and High-End Future Scenario (HEFS) (1% AEP +30%) were run to determine the climate change flood extents.
- Hydraulic simulations were run to determine the flood extents caused by a blockage of culverts along the open channel. Historically this has resulted in flooding of the immediate areas.
- Sensitivity tests were run to evaluate the robustness of the model. These included increased and decreased storm duration and increased and decreased Mannings roughness values both in channel and over the floodplain.

4.2.1 Model Results and Flood Mechanism

Figure 4-2 provides an outline of Flood Zone A (1% AEP) and Flood Zone B (0.1% AEP) which show that the Ballycullen Stream remains in bank under both flows. Peak flows within the pipe network indicate that the 1500mm FAS culvert, carries a greater percentage of flow compared to the original culvert, see Section 4.2.3. This confirms the intended outcome of the FAS design, see Section 3.2.3.

The model was also tested for climate change at the 1% AEP event for both the Mid-Range Future Scenario (MRFS, 20% uplift) and the High-End Future Scenario (HEFS, 30% uplift). Neither scenario showed any out of bank flow.

The historical flood event of 2011 occurred as a result of culvert blockage prior to installation of the 1500mm flood alleviation culvert, see Figure 3-2. For this study, culvert blockage was modelled at 67% (approximately two thirds of culvert openings). A 100% blockage scenario was also run which acts as an extreme residual risk. Under both scenarios overtopping of the open channel occurs. Flood waters encroach just within the site boundary of the proposed development under 67% and extend further past the site boundary under 100% blockage.

Figure 4-2: Flood Zone map

4.2.2 Evaluation of Network

The Ballycullen Flood Alleviation Scheme completed construction in 2017 and was designed to increase the capacity of the network. Prior to the scheme the Ballycullen stream was conveyed through a single 1050mm culvert from south to north. The scheme intended to divert approximately 78% of flow to a new, larger 1500mm culvert while the existing culvert would remain active and convey approximately 22% of flow. Analysis of flow between each pipe under the 1% AEP and 0.1% AEP events shows that the flood alleviation culvert conveys a greater proportion of peak flows. The ratio trends closer to the FAS design ratio of 78:22 under the 0.1% AEP event.

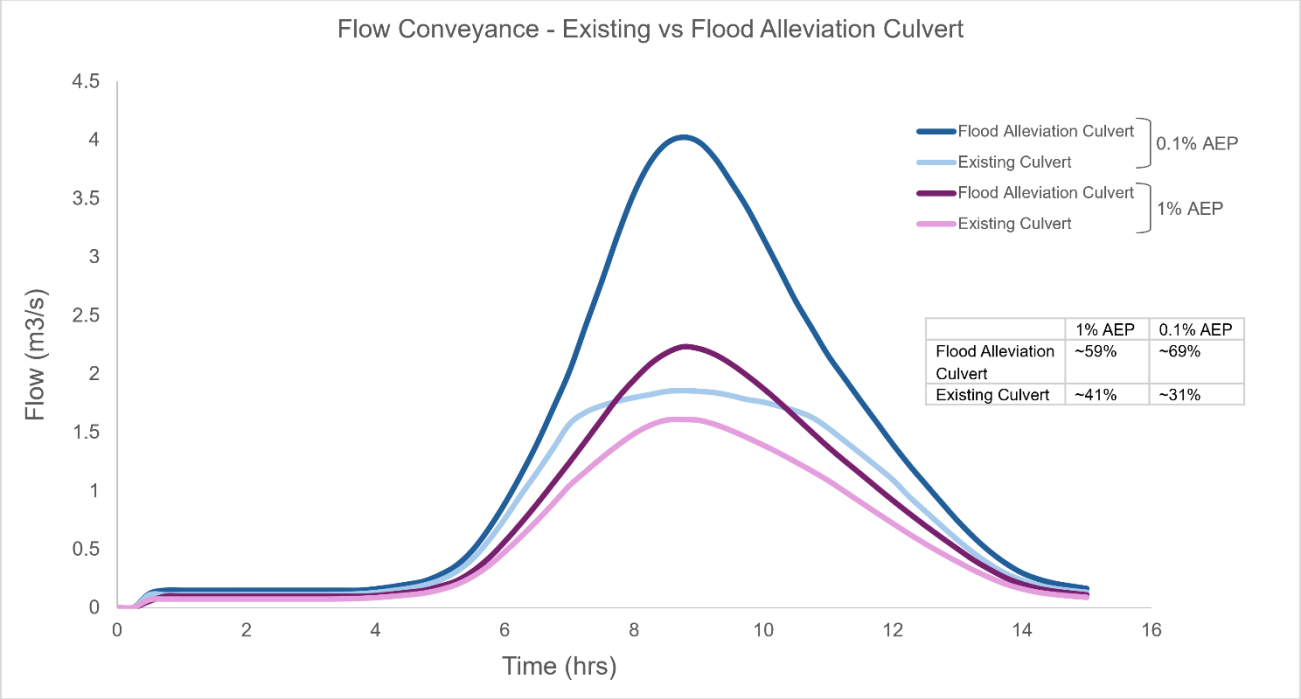


Figure 4-3: Flow conveyance between Ballycullen Stream culverts

5 Flood Risk Assessment and Mitigation

5.1 Flood Risk

The Ballycullen Stream is a heavily modified waterbody with a small section of open channel located to the northwest of the proposed development. The stream is associated with a history of flooding arising predominantly from culvert blockage and culvert capacity issues. Following a flood event in 2011 a Flood Alleviation Scheme (FAS) was commissioned which completed construction in 2017.

Results from the hydraulic model developed in this study show that the site is located in Flood Zone C. The culverted and open channel sections of the stream are able to convey present day flows and increased flows as a result of climate change. This confirms that the site is a low risk of fluvial flooding. Analysis of flows within each culvert demonstrates that the new 1500mm culvert conveys as great a fraction of total flow in the system as the FAS intended.

Residual risk to the site was determined to be blockage of culverts located along the remaining section of open channel. This is discussed further in Section 5.3.

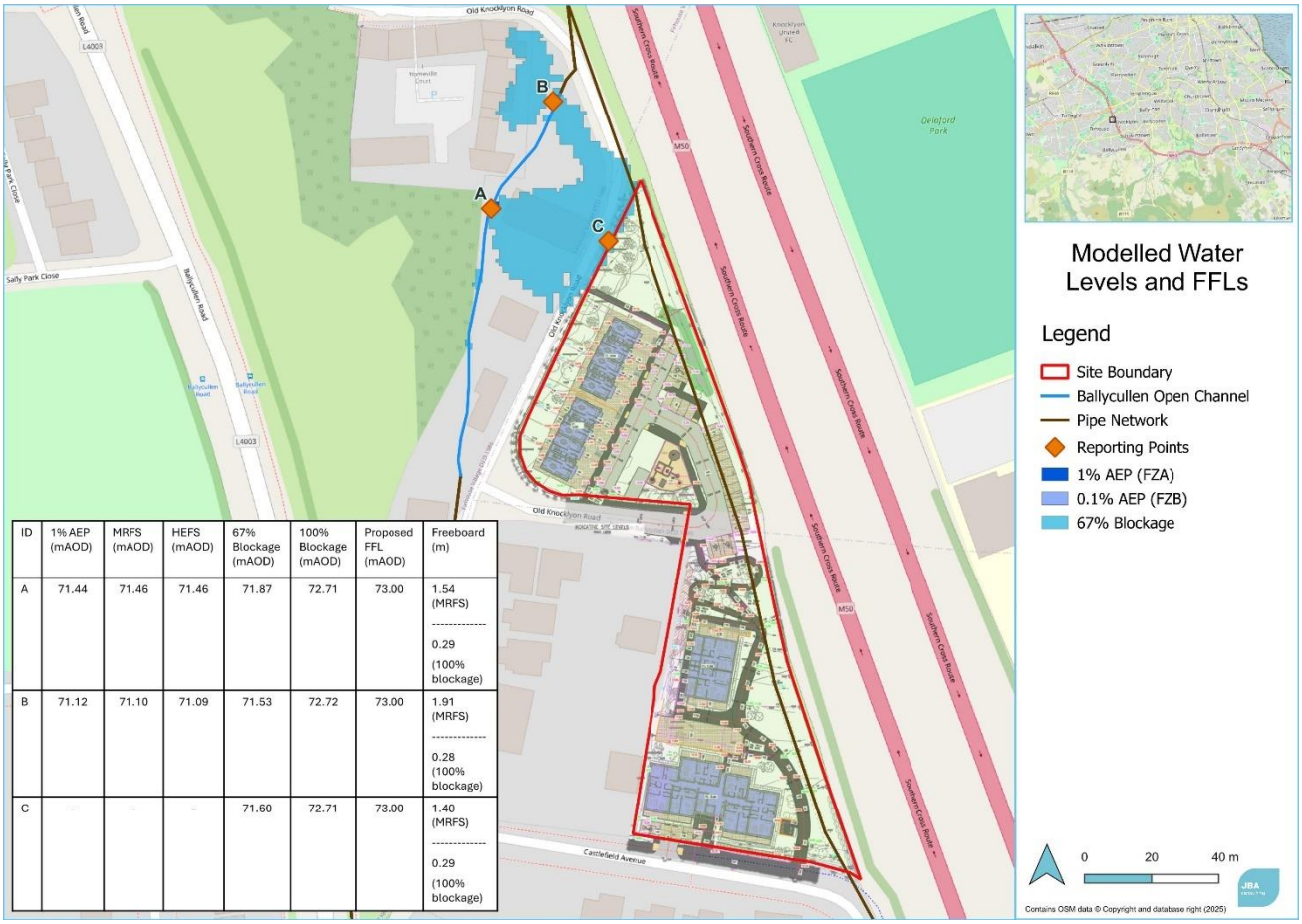
5.2 Mitigation

The development is at low risk of fluvial flooding and pluvial flood risk will be managed through appropriate stormwater and surface water drainage which is discussed in Section 5.2.3.

5.2.1 Site Layout/FFL

The proposed residential development is located within Flood Zone C under all flow and climate change scenarios. The SDCC CDP requires the minimum FFL be HEFS + 300mm freeboard, but residual risk must also feed into the design level.

Three reporting points were selected to evaluate FFLs against flood extents and residual risk levels. The main open channel culvert with trash screen (A), the end of the open channel (B), and the northern boundary of the site (C).



ID	1% AEP (mAOD)	MRFS (mAOD)	HEFS (mAOD)	67% Blockage (mAOD)	100% Blockage (mAOD)	Proposed FFL (mAOD)	Freeboard (m)
A	71.44	71.46	71.46	71.87	72.71	73.00	1.54 (MRFS) ---------- 0.29 (100% blockage)
B	71.12	71.10	71.09	71.53	72.72	73.00	1.91 (MRFS) ---------- 0.28 (100% blockage)
C	-	-	-	71.60	72.71	73.00	1.40 (MRFS) ---------- 0.29 (100% blockage)

Figure 5-1: Water levels and design FFLs and freeboard

The site will comprise four blocks of residences, two in the northern section and two in the southern. The sections will be connected by footpaths. Road levels range from 72.66 - 73.10 mAOD with FFLs between 73.00 - 73.20 mAOD in the northern section. In the southern section road levels range from 73.04 - 78.74 mAOD and FFLs between 77.30 - 78.80 mAOD.

Table 5-1: Maximum water levels, FFLs and associated freeboard

ID	1% AEP (mAOD)	MRFS (mAOD)	HEFS (mAOD)	67% Blockage (mAOD)	100% Blockage (mAOD)	Proposed FFL (mAOD)	Freeboard (m)
A	71.44	71.46	71.46	71.87	72.71	73.00	1.54 (MRFS) ---------- 0.29 (100% blockage)
B	71.12	71.10	71.09	71.53	72.72	73.00	1.91 (MRFS) ---------- 0.28 (100% blockage)
C	-	-	-	71.60	72.71	73.00	1.40 (MRFS) ---------- 0.29 (100% blockage)

It is recommended that FFLs be raised by 0.02m (to 73.02 mAOD) to accommodate the maximum level of residual risk.

5.2.2 Access

The proposed development will have one access point located at the southern boundary along Castlefield Avenue. This entrance is located in Flood Zone C and model results indicate that this entrance will not be impacted by the 1% AEP event, climate change, or culvert blockage.

Access to the development during a flood event is not considered to be an issue.

5.2.3 Stormwater Design

Stormwater and surface water management for new developments should be designed in full accordance with the Greater Dublin Sustainable Drainage Strategy (GDSDS), the specific requirements of the SDCC CDP 2022-2028 and the SDCC SuDS Design and SDCC Sustainable Drainage Systems (SuDS) Explanatory, Design and Evaluation Guide, 2022. The current greenfield runoff rates must be maintained post-development.

A combination of SuDS components such as filter drains, permeable paving and tree pits, will provide approximately 385m^3 of attenuation storage across the site.

5.3 Residual Risks

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. This study identifies one main source of residual risk to the proposed development which is culvert blockage along the open channel. Blockage of these culverts was the source of flooding in 2011.

Organic matter and debris can collect at the trash screen creating a barrier to flows. At 67% blockage overtopping occurs and flood waters reach the proposed development site boundary. At a 100% blockage, water enters the site in the northern boundary, but the proposed access location is to the south of the site and is not affected by the flood extents. Design Finished Floor Levels (FFLs) have a freeboard over the minimum requirement of the MRFS water levels + 300mm, however, we recommend these be raised to sit above the 100% blockage water levels as a precautionary measure against an extreme residual risk level (see Section 5.2.1).

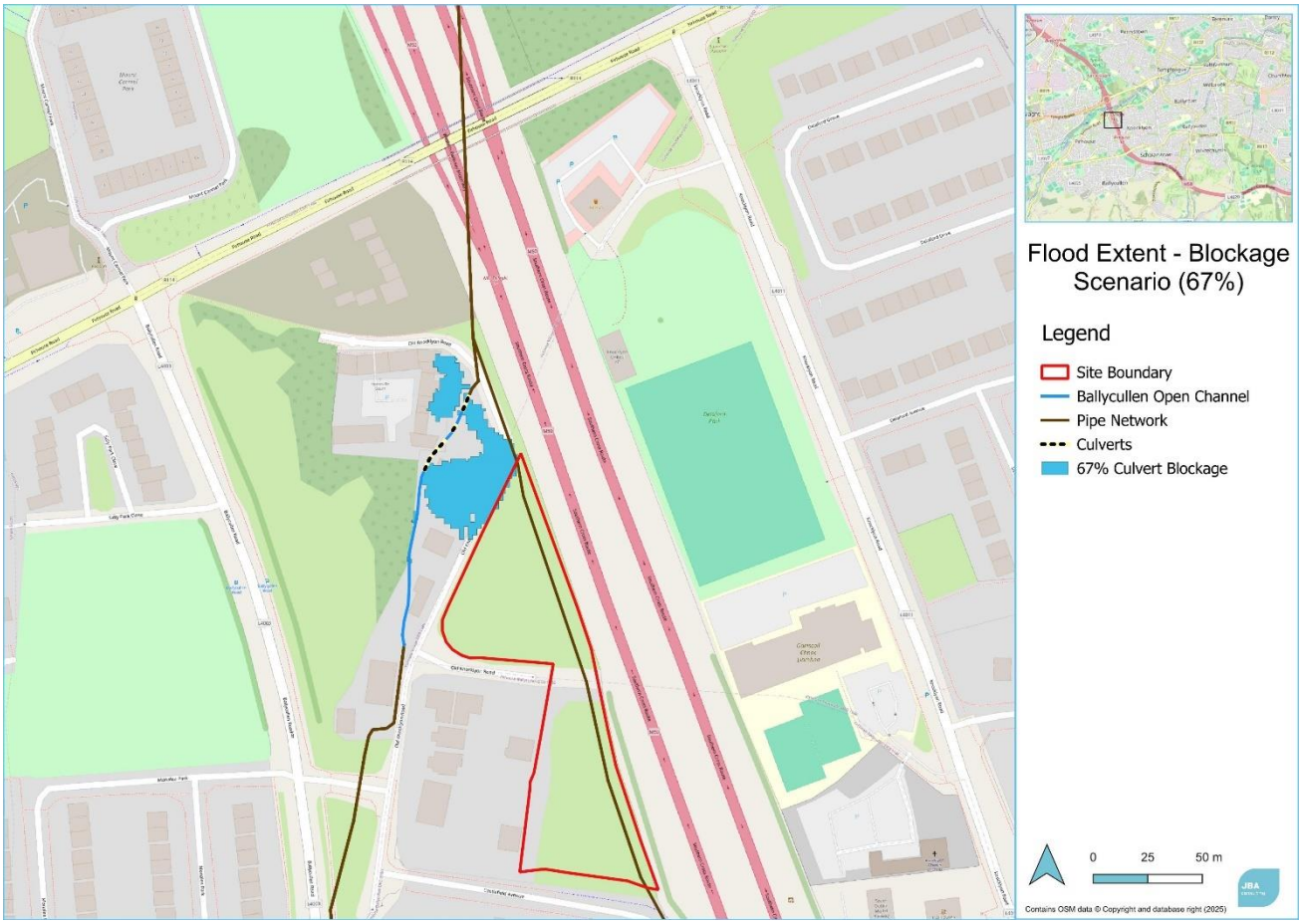


Figure 5-2: Culvert blockage flood extent

5.4 Climate Change

The assessment of flood risk to the proposed development as a result of climate change is based on the Medium Range Future Scenario (MRFS) and High-End Future Scenario (HEFS) which translates to an increase of 20% and 30% in 1% AEP peak flood flows, respectively. With reference to Figure 5-3, which displays the modelled MRFS and HEFS water levels, it is confirmed that the proposed development is located above the maximum water levels and will not be affected by the potential impact from climate change.

Figure 5-3: Climate change flood extents

6 Conclusion

JBA Consulting has undertaken a detailed Flood Risk Assessment for the proposed residential development at Old Knocklyon Road, Knocklyon, Co. Dublin. The proposed works involve the construction of a residential development on a greenfield site. The Ballycullen Stream is a heavily modified waterbody with a small section of open channel located to the northwest of the proposed development.

The Strategic Flood Risk Assessment conducted as part of the South Dublin County Council County Development Plan 2022-2028 indicated that the site may lie in Flood Zone B and may therefore be at risk of flooding. The Eastern CFRAM Study did not cover the areas adjacent to the site. A review of historical data shows that adjacent areas to the site have experienced flooding. In 2011, flooding resulted in damage to several properties and a Flood Alleviation Scheme (FAS) was commissioned which completed construction in 2017. The aim of the selected option of the scheme was to increase capacity which was achieved through the installation of 1.5km of 1500mm culvert that was designed to convey approximately 78% of flows, while the original culvert would remain operative and convey approximately 22% of flows.

A hydraulic model was developed to assess flood risk from the Ballycullen Stream post scheme which revealed that the site is located in Flood Zone C. Flood maps were produced for the 1% AEP and 0.1% AEP events (Flood Zones A and B respectively) which show that no channel overtopping occurs. The culverted and open channel sections of the stream are also able to convey increased flows as a result of climate change, showing that the proposed development is not at risk of fluvial flooding as a result of climate change. Analysis of flows within each culvert demonstrates that the new 1500mm culvert conveys a greater fraction of total flow in the system as intended.

The main residual risk to the site is blockage of culverts located along the remaining section of open channel. Organic matter and debris can collect at the trash screen creating a barrier to flows. At 67% blockage overtopping occurs flood waters reach the proposed development site boundary. At a 100% blockage, water enters the site. Design Finished Floor Levels have a freeboard over the minimum requirement of the MRFS water levels + 300mm, however, we recommend these be raised to sit above the 100% blockage water levels as a precautionary measure. The scheme does not significantly change ground levels and under a residual risk scenario there is not increase in flood risk elsewhere.

The proposed development will incorporate a combination of SuDS features with an approximate capacity of 385m^3 to manage surface water and pluvial flood risk. These include permeable paving, tree pits, and filter drains.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and confirm that the development resides in Flood Zone C 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.).

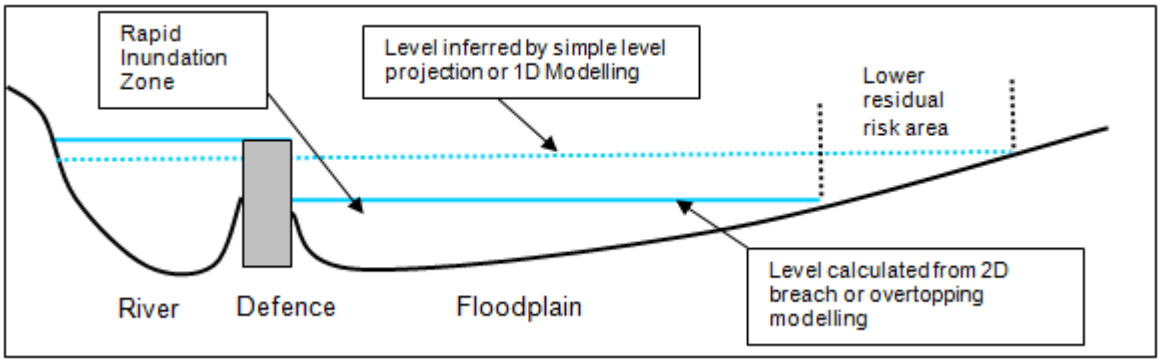
The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

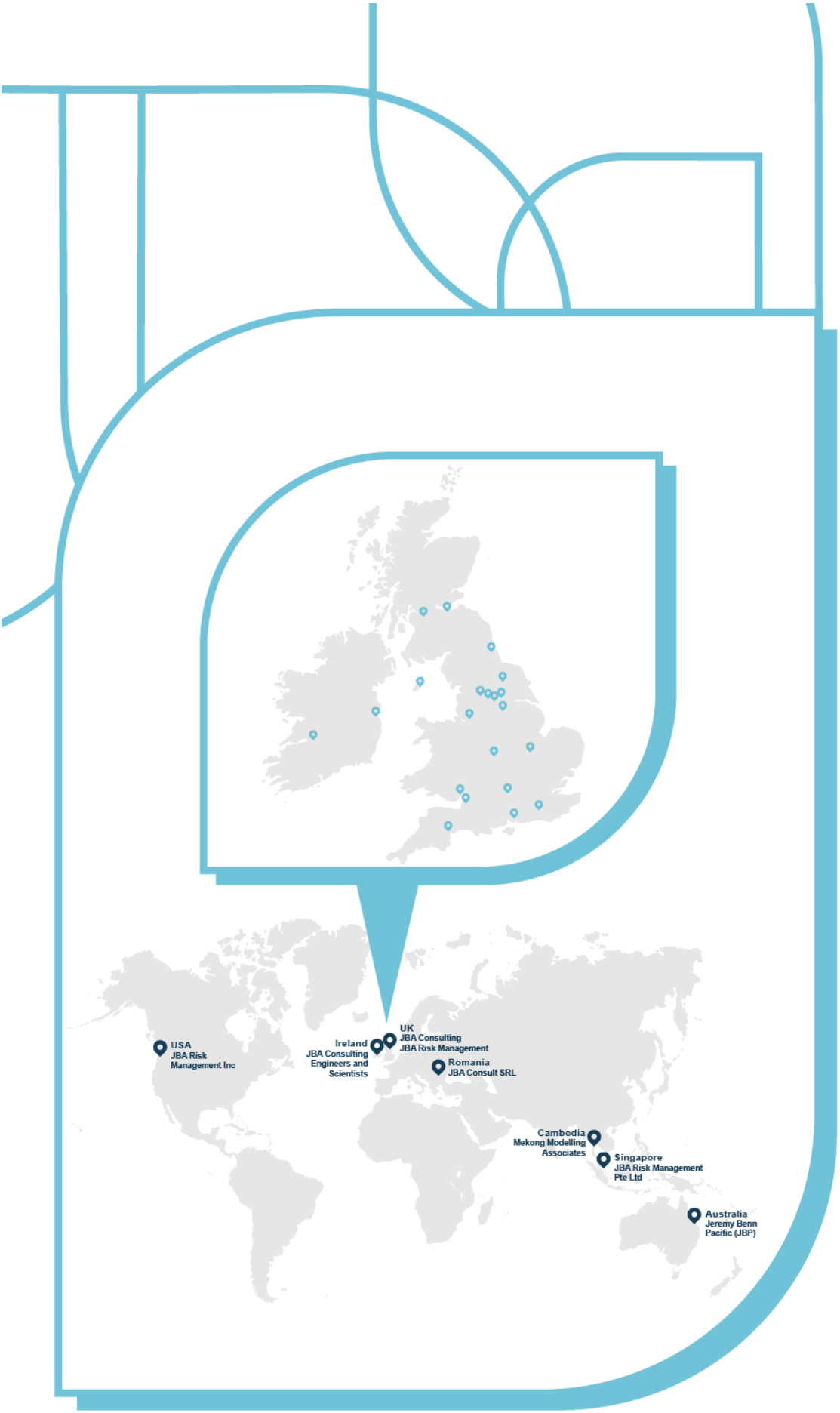
Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;

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.





JBA consulting

Offices at

Bristol
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Leeds
Limerick
Newcastle upon Tyne
Newport
Peterborough
Portsmouth
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
Follow us:

Jeremy Benn Associates Limited

Registered in England 3246693

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
ISO 27001:2013
ISO 45001:2018