Fortunestown Lane, Saggart, Dublin
Flood Risk Assessment Technical Note

Technical Note

May 2024

Greenacre Residential DAC

18 - 19 Harcourt Street

Dublin 2

D02PR84

JBA Project Manager

Hannah Chisnall
2f Lincoln House
Lincoln Lane
Arran Quay
Dublin
D07 Y75P

Revision History

Revision Ref / Date Issued	Amendments	Issued to
S3-P01 / 15/05/2024	Draft Report for comment	DBFL Consulting Engineers/ Greenacre Residential DAC
S3-C01 21/05/2024	Final report following comment	DBFL Consulting Engineers/ Greenacre Residential DAC

Contract

This report describes work commissioned by John Carr (DBFL Consulting Engineers), on behalf of Greenacre Residential DAC. Hannah Chisnall of JBA Consulting carried out this work.

Prepared by .... Hannah Chisnall BA.Mod (Hons) MSc
Analyst

Reviewed by .... Ross Bryant BSc MSc CEnv MCIWEM C.WEM
Principal Analyst

Purpose

This document has been prepared as an FRA technical note for Greenacre Residential DAC. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Greenacre Residential DAC.

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of if 100% post-consumer recycled paper is used and if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Contents

List of Figures

List of Tables

Abbreviations

1D .... One Dimensional (modelling)

2D .... Two Dimensional (modelling)

AEP .... Annual Exceedance Probability

CFRAM........................... Catchment Flood Risk Assessment and Management

FB.................................... Freeboard

FFL .... Finish Floor Levels

FRA .... Flood Risk Assessment

FSR .... Flood Studies Report

FSU .... Flood Studies Update

OPW............................... Office of Public Works

PFRA.............................. Preliminary Flood Risk Assessment

SAAR.............................. Standard Average Annual Rainfall (mm)

SFRA.............................. Strategic Flood Risk Assessment

URBEXT .... FEH index of fractional urban extent

WL .... Water Level

1 Introduction

This technical note has been written to support a proposed planning amendment to a granted planning application for a residential development at Fortunestown Lane, Saggart, Co. Dublin (granted application ref: SHD3ABP-305563-19). Refer to Figure 1-2 for site location and the watercourses considered.

The proposed amendment involves the addition of additional stories at the top of the apartment blocks and an enlarged basement below the blocks previously granted permission. A full Stage 3 FRA was submitted as part of the parent application with proposed mitigation measures to protect the site and surrounding area from flooding included (original document ref: 2019s0507, provided in Appendix A).

This note references key sections in the 2019 FRA and provides additional comments and hydraulic modelling to show that the proposed development and FRA work is still acceptable. Given the lapse of time since the original application and assessment the hydrology and hydraulic model have also been reviewed for completeness and to confirm that the findings are still fit for purpose.

Following pre application discussions with the local authority (REF: LRD23A/005/23), a number of points for consideration in relation to flood risk were raised in the LRD Opinion Report (refer to Figure 1-1). This technical note also addresses the points raised in the LRD Opinion Report.

4. Flood Risk Assessment

The applicant has stated in their submitted Infrastructure Design Report prepared by DBFL that:

"The proposed amendments which are the subject of this application do not affect flood risk or the mitigation measures proposed in the Flood Risk Assessment provided with the parent permission. Therefore, it is considered that the findings of the report are unchanged by the proposed amendments. Following the implementation of the mitigation measures proposed in the FRA, the development area is in in Flood Zone C (Low Risk of Flooding) which is appropriate for residential development."

However, having reviewed South Dublin County Development Plan Strategic Flood Risk Assessment Report and associated SFRA Maps a significant area of the proposed development appears to be in Flood Zone A. in addition as stated in the South Dublin County Development Plan Strategic Flood Risk Assessment Report; Development in Flood Zone A should consist of water compatible development only. Highly Vulnerable Development shall not be permitted in Flood Zone A or B. In addition, the applicant has stated in their submission that they have climate change allowance of 10% under their flood risk assessment where the OPW states there should be a flood climate change allowance of +20% in Flood Parameters for Mid-Range and High End Future Scenarios.

Figure 1-1: Extract from LRD Opinion report (public Realm)

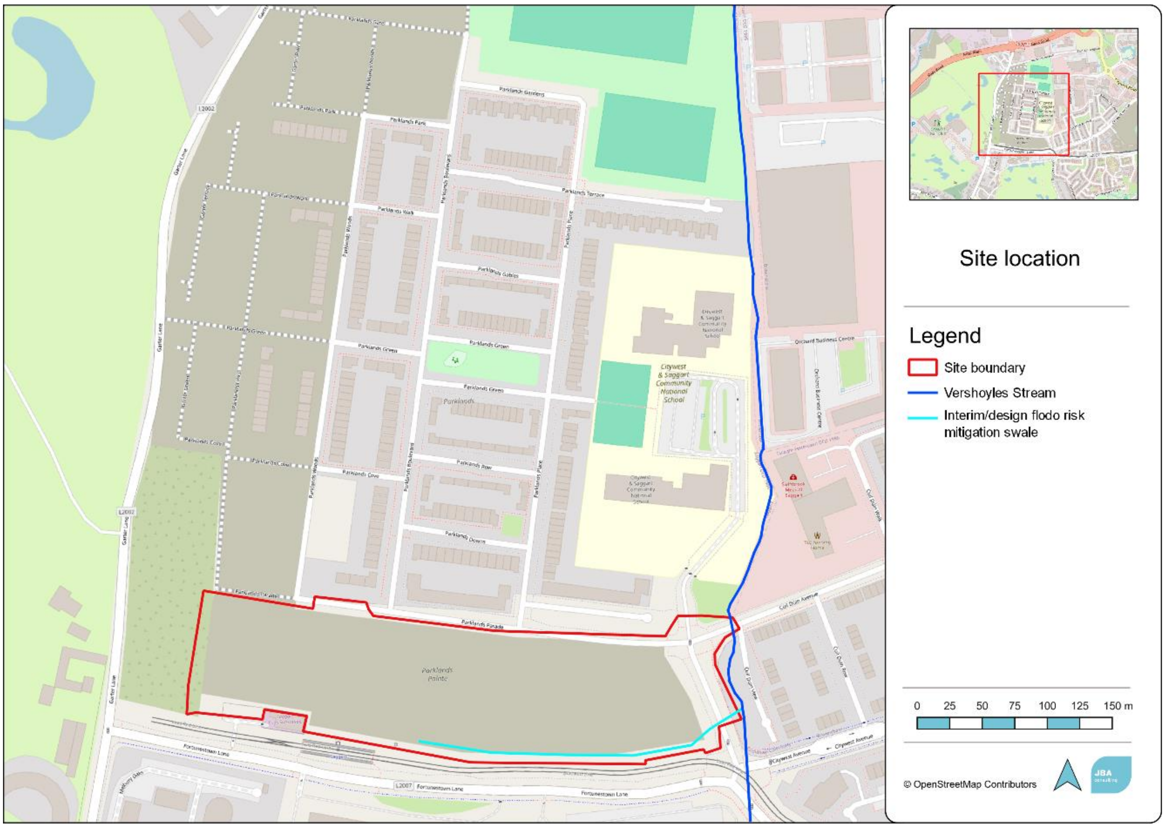


Figure 1-2: Site location

2 Hydrology Review

The peak flow estimates for the study are discussed in Section 4.1 of the 2019 FRA. Given the lapse of time the method applied and final flow values used have been reviewed to ensure that they are fit for purpose. Review of the hydrology showed two datasets used to define catchment descriptor values have been updated/changed during the elapsed period - SAAR (Standard Average Annual Rainfall) and URBEXT (urban area within the catchment). Table 2-1 compares the previous values used in the original FRA and the updated values.

Table 2-1: Changes in Catchment Descriptors

Descriptor	2019 FRA values	2024 values
SAAR	859.52	952.33
URBEXT	0.002	0.007

The method for estimating Qmed (IH124) and the growth curve applied (ECFRAM small catchments curve) are still considered appropriate for the study. Table 2-2 compares the 2019 FRA peak flow values with revised flows estimated using the same method but with updated SAAR and URBEXT values. There is an increase in estimated flow when the updated descriptors are used with a maximum increase of approximately 1m^3/s at the 0.1% AEP event. Overall, the difference in the peak flow is considered minimal but as a conservative approach the revised higher flows have been used in any of the updated hydraulic modelling discussed in this technical note.

Table 2-2: Updated Peak Flow Estimates (m^3/s)

AEP event (%)	2019 FRA values	2024 values
50%	1.32	1.49
1%	4.39	4.95
0.1%	7.82	8.84

3 Hydraulics Review

Similar to the hydrology estimates, given the lapse of time the hydraulic model used to assess the site has been reviewed. The model was found overall to still be fit for purpose however, it is noted that in the time since the completion of the project there has been development in the area. Residential dwellings have been constructed to the north of the site and interim flood risk mitigation measures have also been put in place to protect the area during the construction phase.

An interim channel has been constructed that intercepts overland flow coming from the south, protecting the site. These changes mean that the previous baseline scenario modelling is now out of date and needed to be updated. Additional survey data of the interim channel was collected, and the data used to update the baseline scenario hydraulic model which was then run with the updated peak flow estimates discussed in Section 2. The resulting flood mapping from the updated model is shown in Figure 4-2.

4 Flood Risk in Relation to the South County Dublin Development Plan 2022 - 2028 Strategic Flood Risk Assessment (SFRA)

4.1 Flood Zone Definition

The LRD comments raised reference the SFRA flood mapping for the South County Dublin Development Plan which shows the site to be in Flood Zone A/B. The county development plan is the overarching document for any development within the wider South Dublin area with the SFRA outlining Flood Zone locations and applications of the Justification Test. The site is zoned RES-N under the current development plan. Figure 4-1 shows the flood zoning from the SFRA in of the most recent development plan, released in 2022, the initial application was submitted and approved on the 03/02/2020 under the previous development plan.

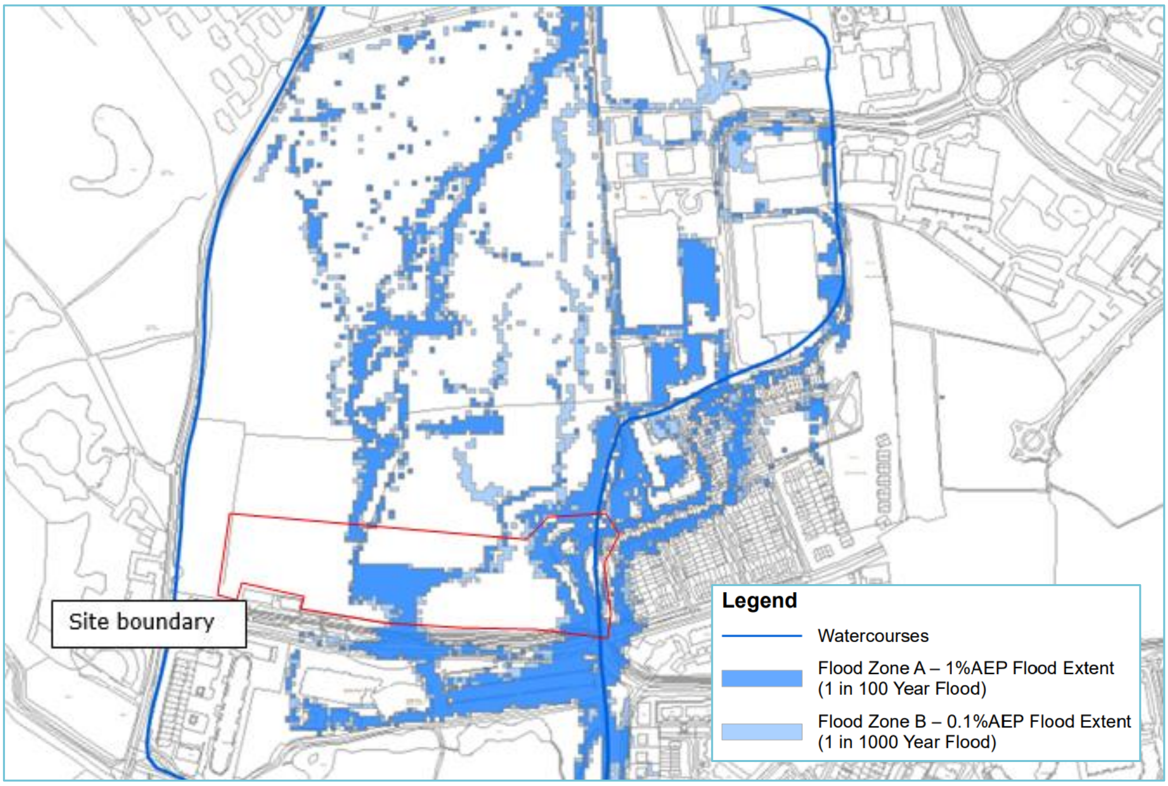


Figure 4-1: South Dublin County Development Plan 2022 - 2028 SFRA Flood map extract (source: https://www.sdcc.ie/en/devplan2022/adopted-plan/environmental-reports/sfra-flood-zone-mapping-maps.pdf)

The site is shown to be in Flood Zone A/B. However, this mapping is based on the outputs from the Eastern CFRAM study which is discussed in Section 3 of the 2019 Stage 3 FRA submitted.

It is noted that within the current SFRA Flood Zone A and B are defined not by the present day CFRAM flood extents but the High-End Future Scenario (HEFS) climate change flood extents. Hence the extents appear larger in the SFRA mapping compared to the present day ECFRAM mapping shown in Section 3.2 of the 2019 FRA report.

The mapping in the SFRA aim to define Flood Zone A & B and therefore do not consider the mitigation measures associated with the granted application discussed and tested in Section 4.3/5.1 of the 2019 FRA. Further to this the SFRA mapping also does not account for the interim flood protection measures that are currently in place at time of writing which also mitigate against the flooding. The interim measures involve a swale across the southern boundary of the site to capture overland flow moving from south to north. The granted application mitigation measures will operate in a similar manner but are more refined in terms of design, refer to Section 4.3 of the 2019 FRA for more details.

Figure 4-2 shows the modelled present-day flood extents for the area when the interim mitigation measures are in place and Figure 4-3 the present day flood extents with the granted planning application mitigation measures in place (all events run with revised peak flows estimated in Section 2). The interim works and those granted under the planning application protect the site from Flood the 1% AEP and 0.1% AEP fluvial events.

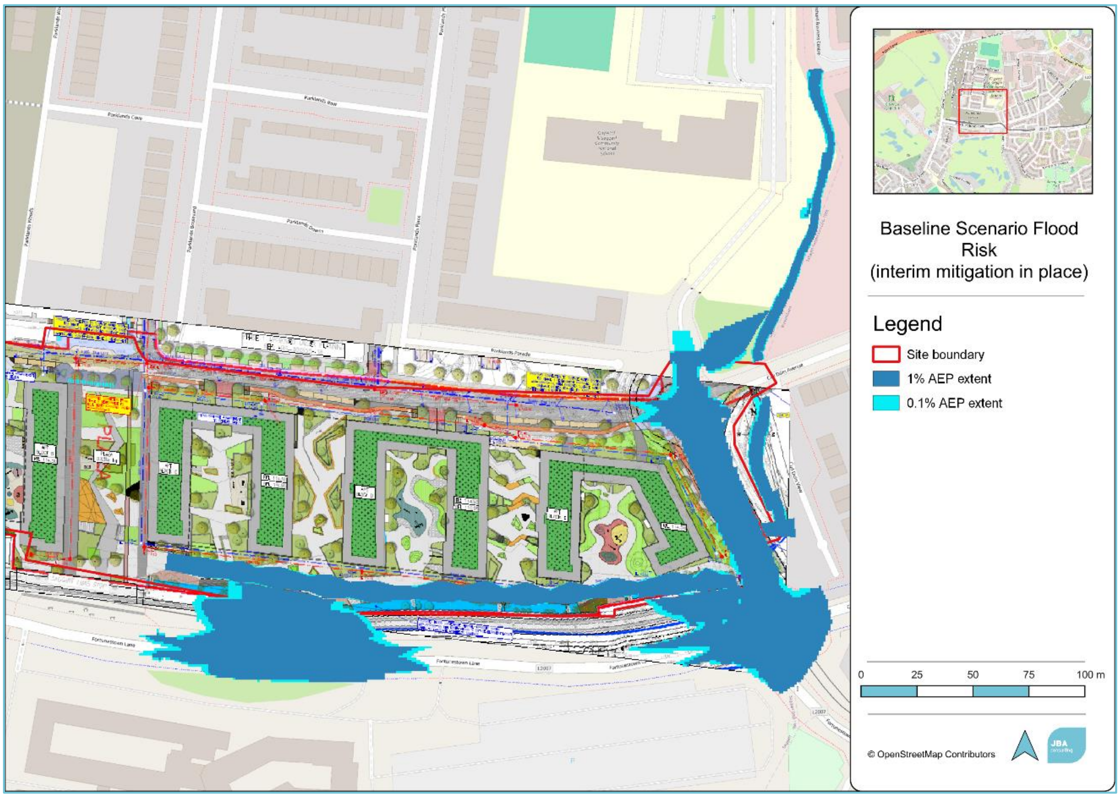


Figure 4-2: Baseline Scenario Flood Risk (interim mitigation in pace)

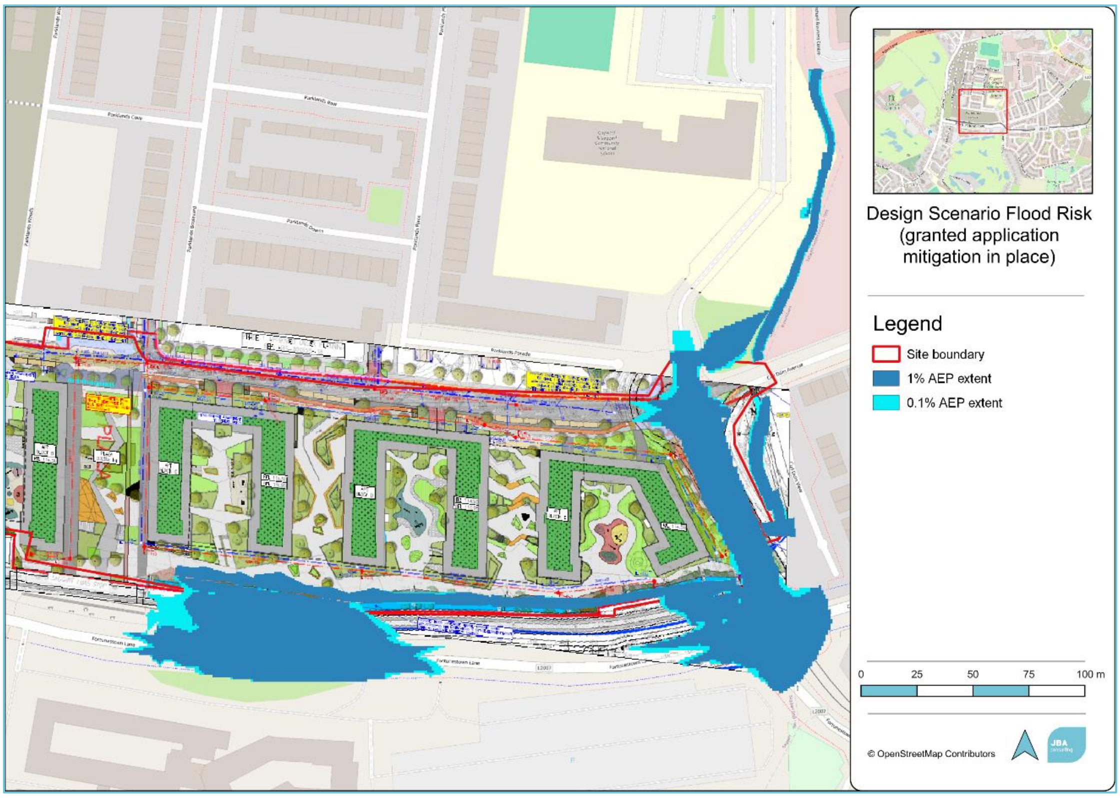


Figure 4-3: Design Scenario Flood Risk (granted application mitigation in place)

4.2 Consideration of Climate Change

The comments raised also refer to the consideration of climate change for the site in relation to flood risk. The comment references a 10% uplift value and the need to consider the Medium-Range Forecast Scenario (MRFS) climate change uplifts which considers a 20% increase in flows. The consideration of climate change was included in the 2019 FRA with the MRFS event (20% uplift) tested in Section 5.5. To comply with the current SFRA which uses the HEFS to denote Flood Zones the 1% AEP HEFS event has been run for the site and mitigation. This event was not previously run in the 2019 FRA as it was not required for the application at the time.

Figure 4-4 shows the climate change flood 1% AEP flood extents for the MRFS and HEFS at the site with the granted application mitigation measures in place (run with updated flow values). The site is protected in the 1% AEP climate change events and at low risk of flooding in both future scenarios.

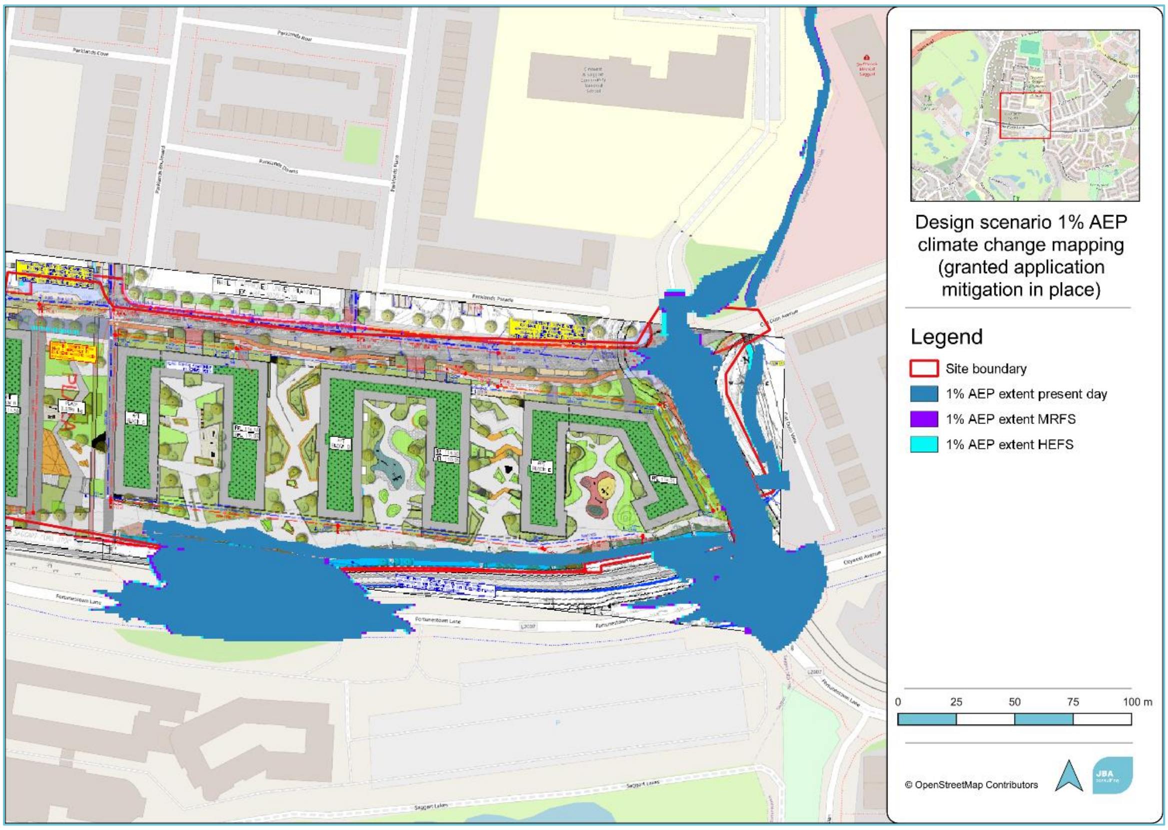


Figure 4-4: Design Scenario 1% AEP Climate Change Mapping (granted application mitigation in place)

5 Summary

This technical note has been written to support a proposed planning amendment to a granted planning application for a residential development at Fortunestown Lane, Saggart, Co. Dublin. A full Stage 3 Flood Risk Assessment was carried for the original application which showed the site to be protected from the 1% AEP and 0.1% AEP events because of mitigation measures.

Review of the Development Plan SFRA mapping places the site within Flood Zone A/B and it is noted that the SFRA flood maps do not consider the constructed interim mitigation measures. To ensure that the results from the previous FRA were still appropriate and in keeping with the requirements of the current SFRA a review of the hydrology and hydraulic modelling was carried out.

The hydrology review found that there was need to update the inflows used due to updated datasets becoming available in the elapsed time which resulted in increased peak flow estimates. The hydraulics review found that the model was still fit for purpose but in the period since the previous FRA was completed interim flood risk mitigation measures had been put in place meaning that the baseline scenario representation had to be updated accordingly.

The hydraulic model was then re-run for both the new baseline and the design scenario for the 1% and 0.1% AEP events using the updated flow values. The modelled results for both scenarios showed the site protected from the 1% AEP and 0.1% AEP events and at low risk of fluvial flooding therefore a Justification Test was not required.

Further to this the design scenario was run for the 1% AEP Medium Range and High End Future Scenarios (MRFS and HEFS) events to account for any increased risk due to climate change. Again, the site was shown to be protected for these events and so is not at increased risk of flooding in the future.

In conclusion this note addresses the comment raised on the amendment to the application and also provides confidence that the modelling is still fit for purpose for the site.

Appendices

A Appendix - 2019 Flood Risk Assessment

Strategic Housing Development at Fortunestown Lane, Saggart Co. Dublin - Flood Risk Assessment

2019s0507

Final Report

September 2019

www.jbaconsulting.ie

DBFL Consulting Engineers

JBA Project Manager

Tim Cooke

Unit 3, Block 660

Greenogue Business Plaza,

Greenogue

Rathcoole,

Dublin

Revision History

Revision Ref/Date	Amendments	Issued to
V1.0 27/06/2019	Draft Report	Dermot Grogan (DBFL)
V2.0 05/07/2019	Draft Report, adjustments made following client feedback	Dermot Grogan (DBFL)
V3.0 16/07/2019	Final Report	Dermot Grogan (DBFL)
V4.0 19/09/2019	Amended Final Report	Dermot Grogan (DBFL)

Contract

This report describes work commissioned by Dermot Grogan, on behalf of DBFL Consulting Engineers. Hannah Moore and Tim Cooke of JBA Consulting carried out this work.

Prepared by .... Hannah Moore BA MSc

Assistant Analyst

Reviewed by .... Tim Cooke BE BSc MIEAUST

Senior Engineer

Purpose

This document has been prepared as a Flood Risk Assessment for DBFL Consulting Engineers. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to DBFL Consulting Engineers.

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 58g if 100% post-consumer recycled paper is used and 73g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Contents

List of Figures

List of Tables

Abbreviations

AEP	Annual Exceedance Probability
CFRAM	Catchment Flood Risk Assessment and Management
DoEHLG	Department of the Environment, Heritage and Local Government
DTM	Digital Terrain Model
EPA	Environmental Protection Agency
GSI	Geological Survey of Ireland
HEP	Hydrological Estimation Point
LiDAR	Light Detection And Ranging
mOD	Meters above Ordnance Datum
MRFS	Medium Range Future Scenario
OD	Ordnance Datum
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
SDCC	South Dublin County Council

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 to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference

JBA Consulting was appointed by Greenacre Residential DAC to prepare a Flood Risk Assessment (FRA) for a proposed development site in City West, Dublin.

1.2 Flood Risk Assessment Aims and Objectives

This study is being completed to inform the future development of this 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 the land, property and people and the measures that would be recommended to manage the risk.

The primary objective is to work with the design team to progress a site design that can manage the impacts of flooding to the site without negatively impacting areas off the site. Additional objectives are to:

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Assess the impact the proposed development has on flood risk,
- Develop appropriate flood risk mitigation and management measures.

Recommendations for development have been provided in the context of the OPW / DoEHLG 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 client has proposed to develop the greenfield site which is zoned for residential development. It is proposed to build five residential apartment blocks (A, B,C,D and E)and surrounding landscaped areas adjacent to the existing Saggart Luas stop (Figure 1-1). There is a basement carpark proposed under Block 'A' at the western end of the site and a second larger basement proposed under blocks 'C', 'D', and 'E.' The proposal is part of phase two of a wider residential development. Phase one of the development has previously been granted planning permission in March 2018 via the SHD planning process, under planning reference ABP 300555-18 (refer to Figure 1-2).

The approved scheme included a flood conveyance channel through the phase 2 development site (subject site) and surface water attenuation and storage measures (in the district park within Phase 1) addressing the phase 1 development and future development of phase 2 lands. The proposed development includes modifications to the flood conveyance channel previously approved. The proposed amendments will refine the channel design in keeping with the proposed development and specifically in keeping with the landscape proposals. This FRA includes hydraulic modelling of the refined flood conveyance channel.

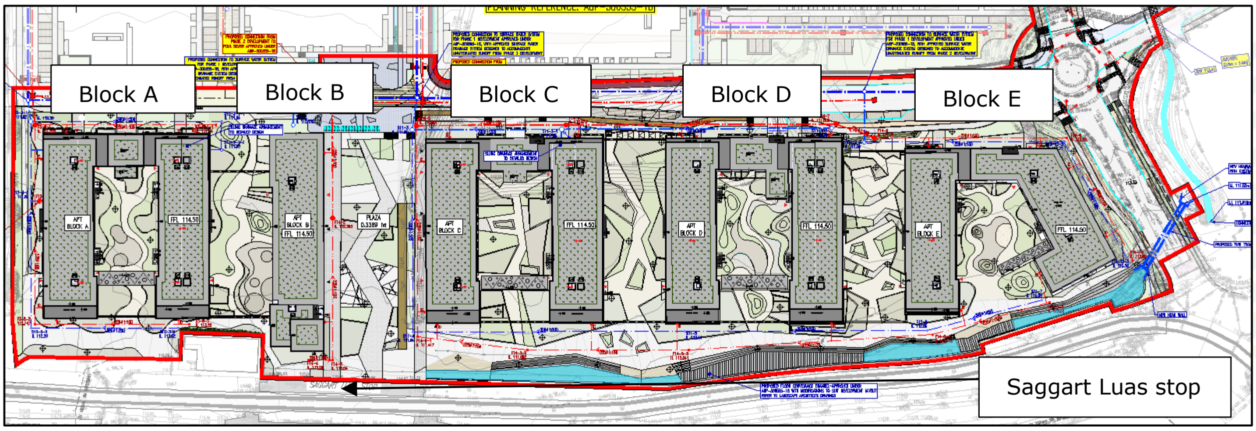


Figure 1-1: Proposed development

Figure 1-2: Proposed development site in relation to the approved Phase 1 development

2 Site Background

This section describes the proposed development site in City West, including the local watercourses and the wider geographical area.

2.1 Site Description

The site is located within City West, Co Dublin, as shown in Figure 2-1. The site is currently a greenfield site and is approximately 3.3ha. The site is to be bounded by residential dwellings from the phase 1 development that are currently under construction to the north and by the Luas Red line and Saggart Luas stop to the south. The site generally slopes in a south to north direction between approximately 116 and 114 mOD.

There are two tributaries of the Camac River which flow near to the east and west (culverted) boundaries of the site, as provided by the EPA database. The most significant tributary of the Camac River is along the east boundary referred to as Vershoyles Stream within the Eastern CFRAM. There is known historical flooding across the site resulting from over bank flows within the former golf course to the south and overland flow at the roundabout adjacent to the south east corner of the site. The flows coming from the former golf course are sufficient enough to cross over Fortunestown road and the Luas line situated across the southern boundary of the site.

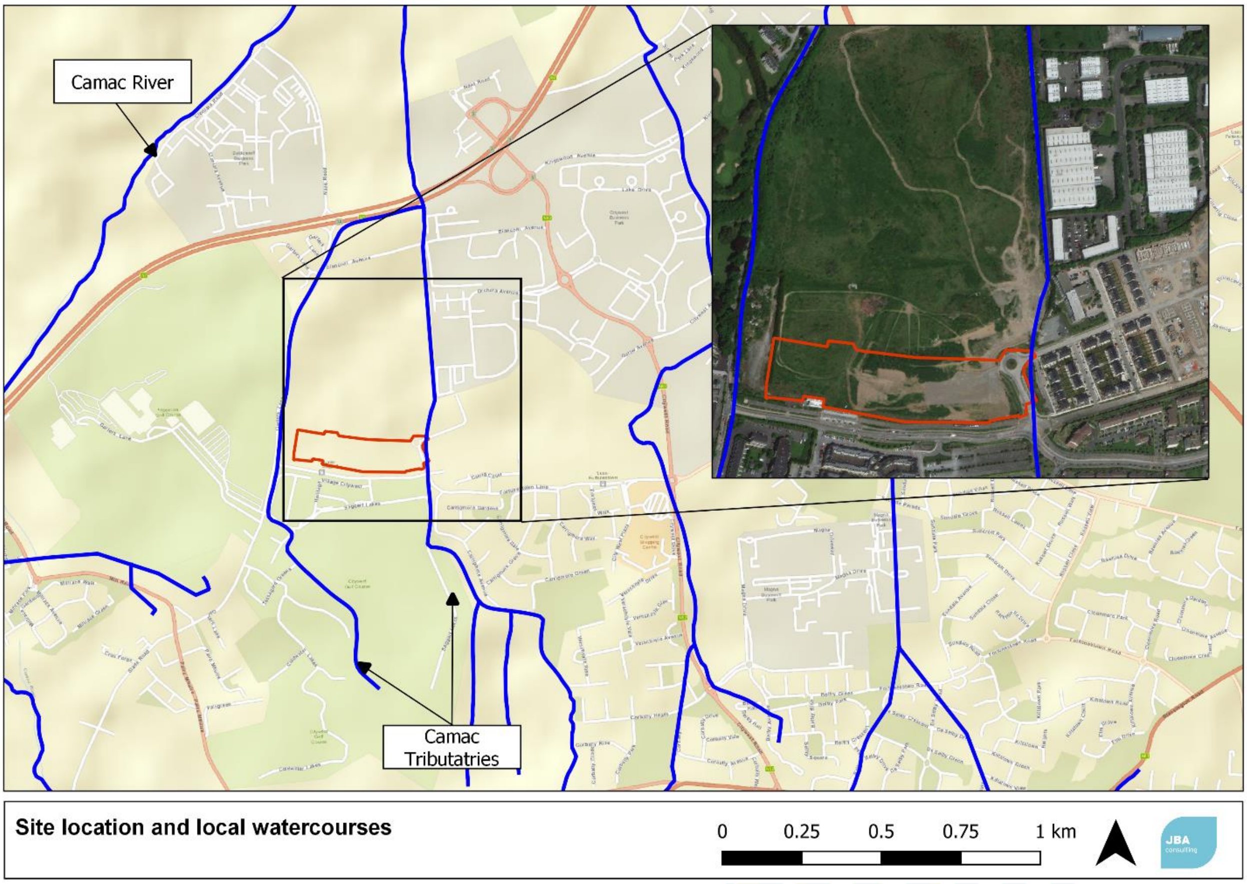


Figure 2-1: Site location and watercourses

2.2 Site Geology

The Geological Survey of Ireland (GSI) groundwater and geological maps of the site were reviewed. The subsoil within the site is made up of till derived chiefly from limestone, refer to Figure 2-2. The surrounding areas to the east and west of the site are made up of made ground with till derived from Palaeozoic rock to the south.

The underlying bedrock is classified as Dinaritian Upper Impure Limestones. There are no karst features located within the site of the immediate surrounding area. The associated groundwater vulnerability which indicated the risk of the underlying waterbody for the site is classified as low at this location.

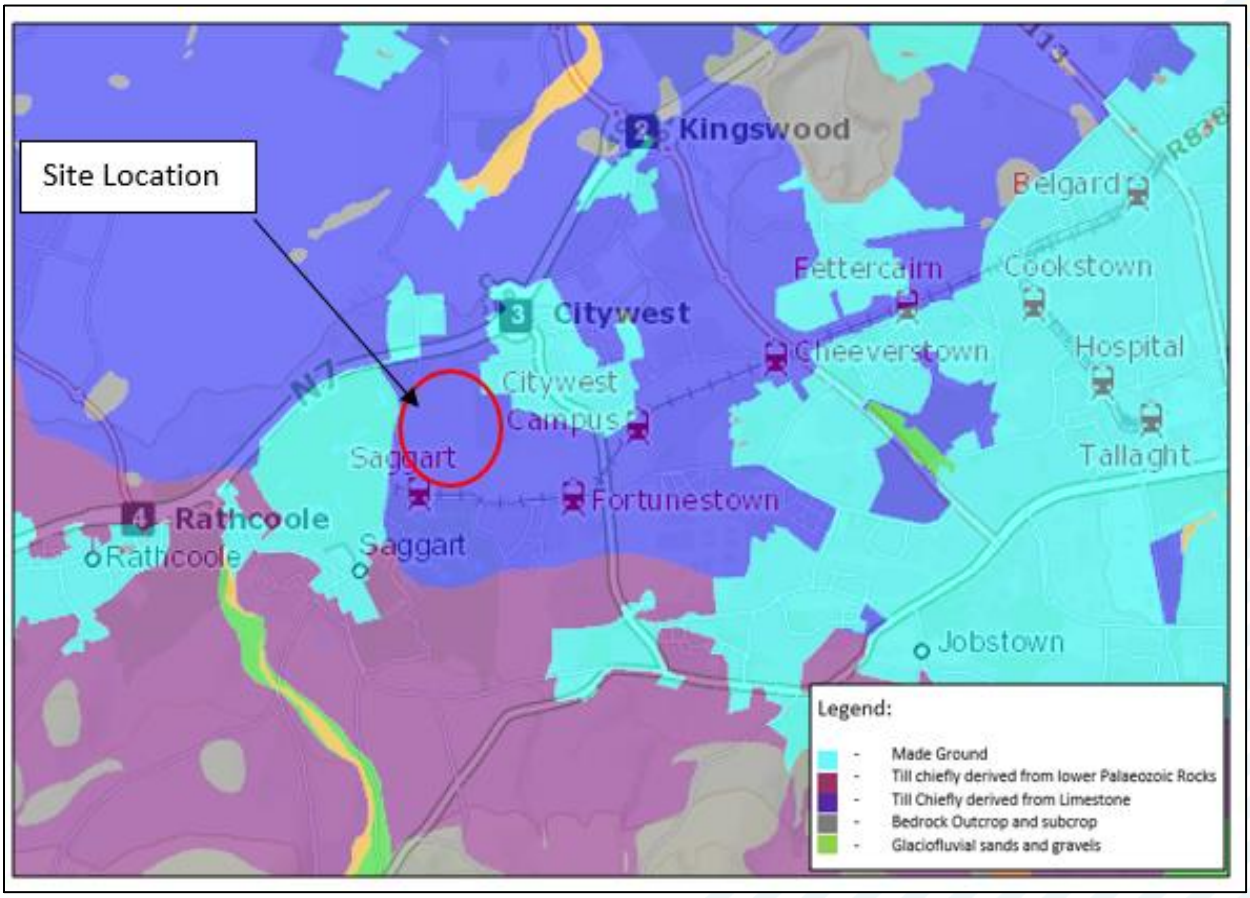


Figure 2-2: Subsoils (GSI)

3 Flood Risk Assessment

An assessment of the potential 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 historic 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 were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's website, www.floodmaps.ie and general internet searches.

3.1.1 Floodmaps.ie

The OPW host a National Flood hazard mapping website, www.floodmaps.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. See Figure 3-1 for historic flood events in the area.

Review of Figure 3-1 does not show instances of historic flooding directly on the site however there have been several recorded flooding events across the south boundary of the site at Fortunestown Road.

- 24th October 2011 - Heavy rainfall resulted in major flooding along the Camac watercourse and its tributaries. The run-off from the golf course spilled onto City West Carpark and Carrigmore Glen. The water pressure between the car park and Fortunestown Lane caused the wall to collapse and water and flooding also occurred further downstream at a new development.
- 5th-6th November 2000 - Heavy rainfalls caused flooding of the Carmac river effecting Fortunestown Lane.
- There is re-occurring flooding identified north of the site in Baldonnel, Barney's Lane. This does not appear to have an effect on the proposed site.

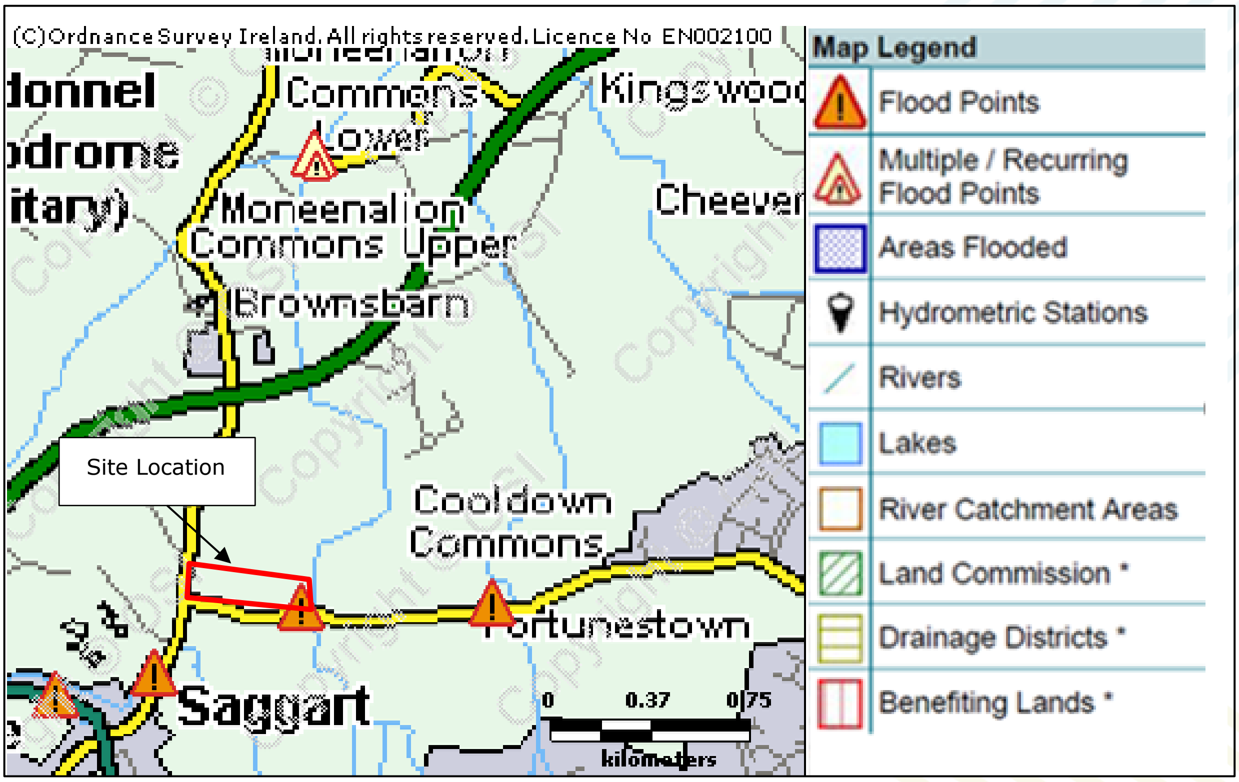


Figure 3-1: Floodmaps.ie

3.1.2 Internet searches

An internet search was conducted to gather information about whether or not the site was affected by flooding previously. There were no search results found for historic flooding at this site other than those mentioned above.

3.2 Predictive Flooding

City West has been subject to predicative flood mapping and modelling.

- OPW Preliminary Flood Risk Assessment (PFRA),
- Eastern Catchment Flood Risk Assessment and Management Study (CFRAM)

The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the OPW PRFA study.

3.2.1 OPW Preliminary Flood Risk Assessment (PRFA)

The preliminary Flood Risk Assessment (PFRA) is a requirement of the EU Flood Directive (2007/60/EC). One of the PFRA deliverables is flood probability mapping for various sources: pluvial (surface water), groundwater, fluvial and tidal. The PFRA is a preliminary or 'indicative' assessment and analysis has been undertaken to identify areas potentially prone to flooding. The OPW PFRA study has largely been superseded by the CFRAM programme for fluvial and tidal sources, however, it remains valuable information particularly regarding pluvial and groundwater flood mapping. The PFRA fluvial flood extents for the site are superseded by the CFRAM fluvial flood mapping programme. See Figure 3-2 for OPW PFRA flood extents at the site and surrounding area.

The PFRA does not identify any pluvial flooding across the site. Pluvial flooding is known to occur on the low-lying areas of the former golf course to the south of the development site.

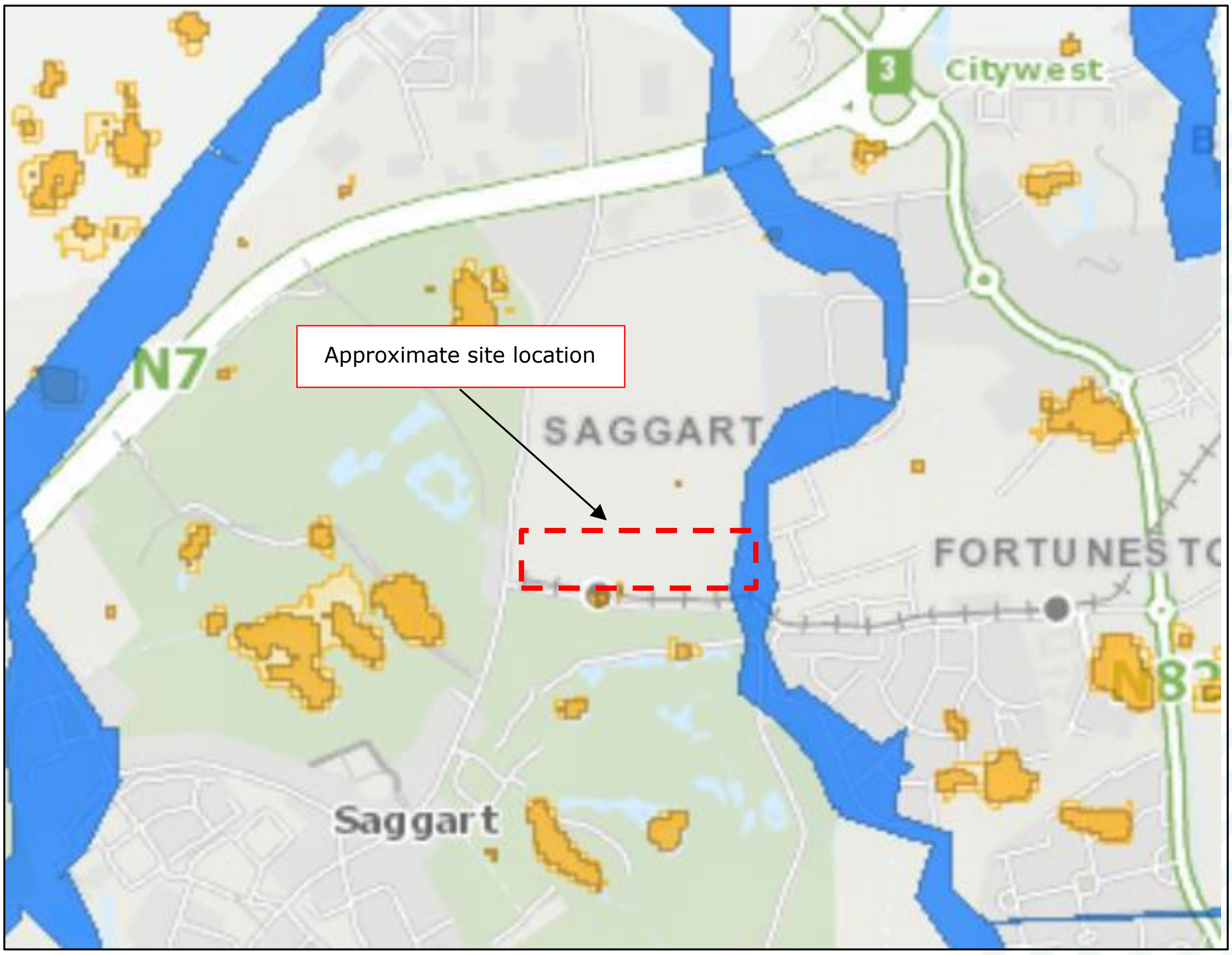


Figure 3-2: PFRA Flood Maps (myplan.ie)

3.2.2 Catchment Flood Risk Assessment and Management Study (ECFRAM)

The Eastern CFRAM study is the most comprehensive flood mapping undertaken in the Dublin region. It commenced in June 2011 with final flood maps issued during 2016. The study involved detailed hydraulic modelling of rivers and their tributaries.

The Eastern CFRAM highlighted the Camac catchment as an Area of Further Assessment (AFA) and a high priority watercourse due to historical flooding and the PFRA flood extents.

3.2.2.1 ECFRAM Hydrology Report

The Camac River is a tributary of the River Liffey and has a total catchment area of 58km^2, with several small steep sub-catchments originating in the foothills of the Wicklow Mountains. The site location, adjacent to Vershoyles Stream, is located within one of these sub-catchments.

The specific model provided for the study area, identified as Model 2D, within the CFRAM Hydrology Report HA09 outlines the various methods used in calculating flow rates for Hydrologic Estimation Points (HEPs). Qmed for all HEPs with the Vershoyles Stream sub-catchment has been determined using IH124 methodology.

The CFRAM hydrology report details the calibration of flows to the Killeen Road Flow Gauge (09035) approximately 7km downstream from the site. As a result, all flows derived from the IH124 methodology on the upper reaches were adjusted downwards in line with the ratio of Qmed at the Killeen Road gauging station to the Qmed derived from the IH124 method at the gauging station location.

The hydraulic estimation points (HEPs), gauging station and subject site location of this FRA are shown in Figure 3-3.

This calibration process takes a catchment wide approach, incorporating a catchment size considerably larger than the site location. The adjustments made within the CFRAM approach may be valid at the total catchment scale but may not be appropriate for a single sub-catchment considered in isolation. Additionally, CFRAM Qmed flows for HEPs within Vershoyles Stream sub-catchment could not be validated through IH124 methodology for either the adjusted or unadjusted values.

To translate Qmed values to peak flows for standard return periods at HEP locations, the ECFRAMS hydrology method assessed 54 catchments under 10km^2 in area and developed a median growth curve to be applied to all small catchments of this size. The pooling of similar catchments where appropriate, provides greater information to develop, and therefore better represent, estimation of growth curves. This is a significant improvement on the one national growth curve developed in the FSR over 40 years ago which only included a limited number of small catchments in its development. The adopted growth curve factors with ECFRAMs for catchments under 10km^2 are provided in Table 3-1.

Table 3-1: ECFRAM Growth Factors for catchments <10km^2

Annual exceedance probability	50%	20%	10%	5%	4%	2%	1%	0.5%	0.2%	0.1%
Growth Factor	1.00	1.45	1.80	2.18	2.32	2.78	3.32	3.96	4.99	5.93

3.2.2.2 Hydraulic Report – Camac Catchment

A 1D-2D hydraulic model was developed incorporating flows determined at each HEP.

HEP flow comparison within the ECFRAM Camac Hydraulic Report notes a significant reduction in flow determined within the hydraulic model when compared directly to the HEP for the Vershoyles Stream Sub-catchment.

At HEP 09_586_3 (Vershoyles Stream catchment) the difference of -38% is due to significant flooding along this tributary with comparatively large areas of ponding. The downstream hydrograph at this check HEP is significantly wider than input hydrographs indicating attenuation of peak flows.

Table 3-2 presents the comparison for hydraulic model peak flows to HEP values for Vershoyles catchment (HEP point 09_586_3).

Table 3-2: Validation of CFRAM Model to HEP calculation point

AEP event	Model 10% AEP	HEP 10% AEP	Model 1% AEP	HEP 1% AEP	Percentage difference in 1% AEP values	Model 0.1% AEP	HEP 0.1% AEP
Flow (m^3/s)	1.43	2.59	2.97	4.79	-38	5.63	8.55

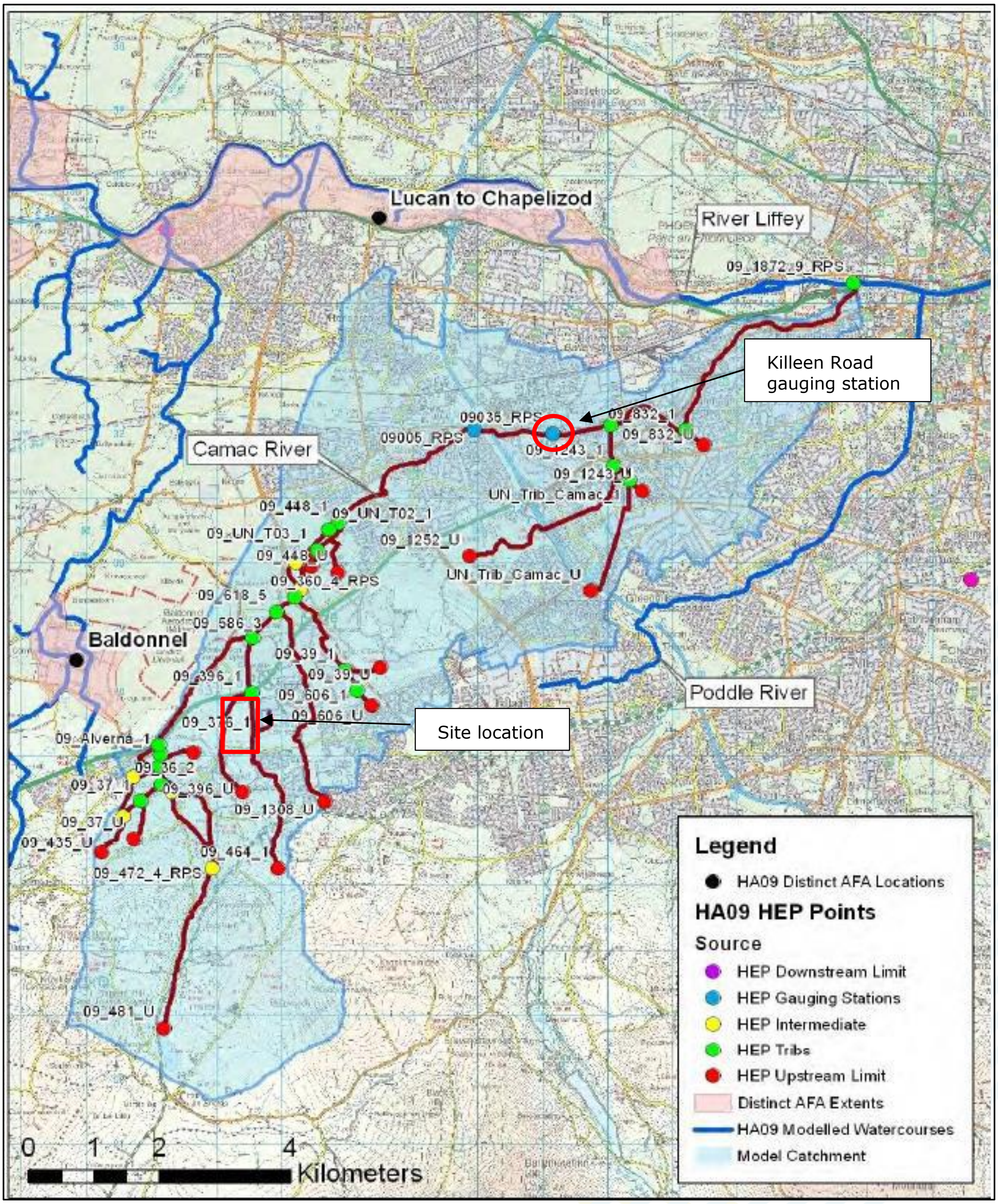


Figure 3-3: Model 2D HEPs and Catchment Boundary (ECFRAM Hydrology Report HA09)

3.2.2.3 ECFRAM Mapping Extents

CFRAM mapping of the 0.1% AEP,1% AEP and 10% AEP flood extents are shown in Figure 3-4. Table 3-3 provides details of the water levels for 10% ,1% and 0.1% AEP at nodes relevant to the site location.

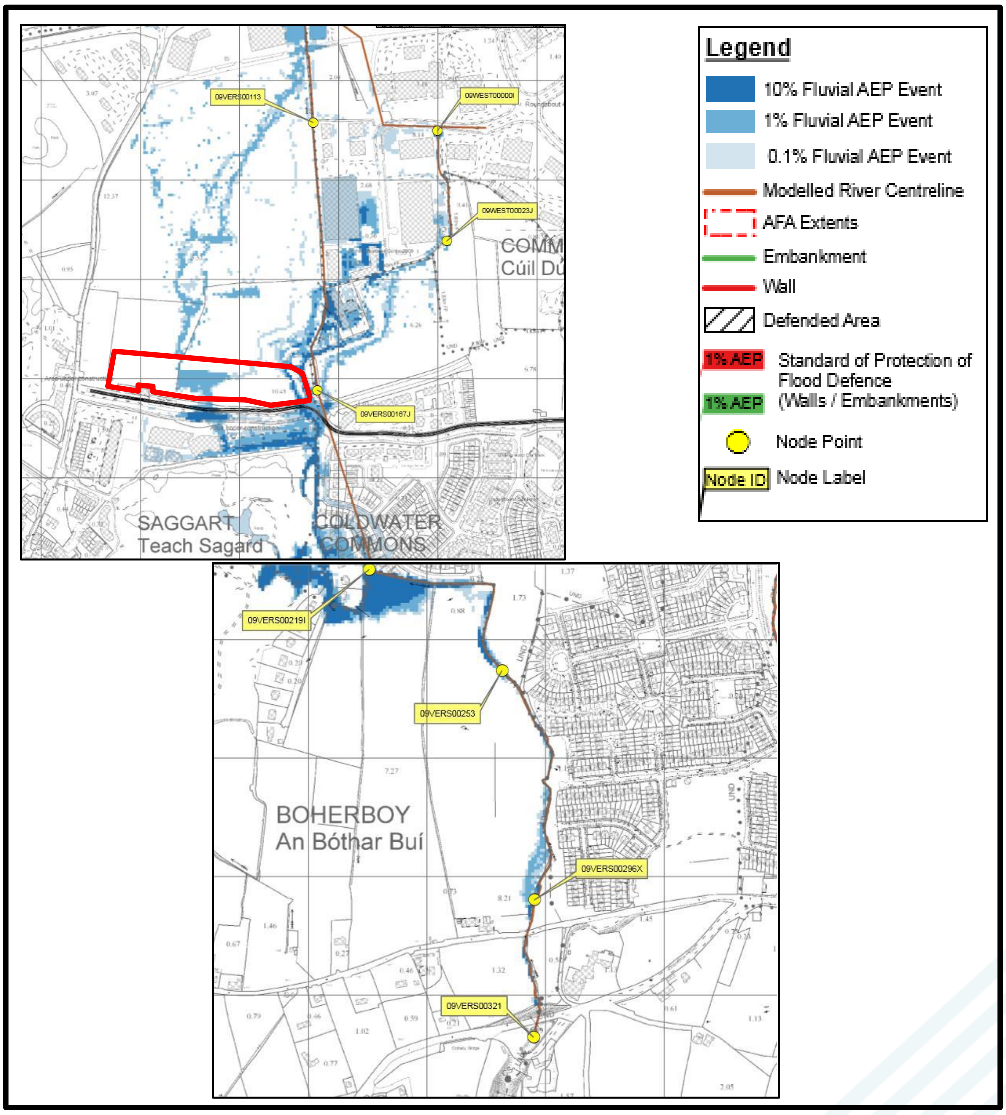


Figure 3-4: CFRAM Fluvial Flood Extents

Table 3-3: Water levels for node points at and around site location

Node	Water Level 10% AEP (mOD)	Water Level 1% AEP (mOD)	Water Level 0.1% AEP (mOD)
09VERS00219I	117.84	118.01	118.13
09VERS00167J	111.46	n/a	111.64
09VERS00113	102.63	n/a	103.01

It is clear in the flood extents in Figure 3-4 that the exceedance of capacity at the entrance to culvert VERS00219 is primarily responsible for all out of bank flooding from Vershoyles Stream upstream of the N7 Naas Road. Substantial ponding occurs at the culvert entrance with floodwaters spilling to the west between residential blocks. The overland flow path then runs north along the eastern boundary of the former golf course. Significant attenuation and ponding appears to occur within this former golf course. The flow path splits at the carpark to the south of Fortunestown Road.

The main flowpath continues across Fortunestown Road where the flow further separates. Some flow continues along the road, some enters the south-east corner of the site, and some returns to the open channel of Vershoyles Stream. The secondary flowpath from the carpark heads west, where it then turns northwards across Fortunetown Road and the Luas Line. This flowpath enters the site from the southern boundary east of the Saggart Luas stop in the 0.1% and 1% AEP events. Flows in the 0.1% and 1% AEP event are predicted to cross the centre of the site and travel from the southern boundary to the north-east corner of the site where it returns to Vershoyles Stream at Bianconi Avenue.

There is no flooding across the site in the 10%AEP event, indicating that overland flow paths only occur in large events, with no fluvial flooding occurring in more frequent events.

Flood depths occurring onsite for both the 1% and 0.1% AEP events are shallow and generally shown to be less than 0.25m. Isolated locations of deeper ponding are a result of ponding behind temporary soil stockpiles onsite. These areas are not representative of actual flood depths for natural ground levels of the site.

Downstream of the subject site and the Phase 1 development site overland flow paths across the site return to Vershoyles Stream between Binaconi Avenue and the N7 Naas Road.

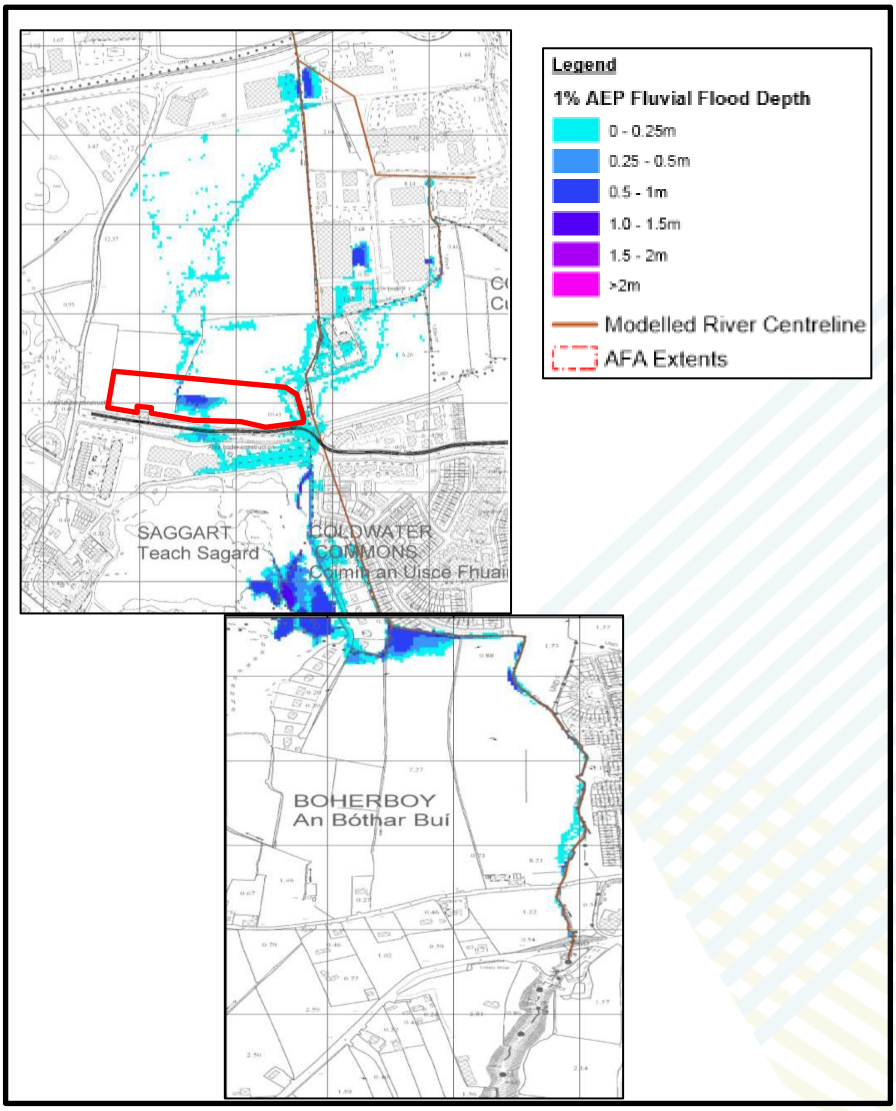


Figure 3-5: 1% AEP Fluvial Flood Depths

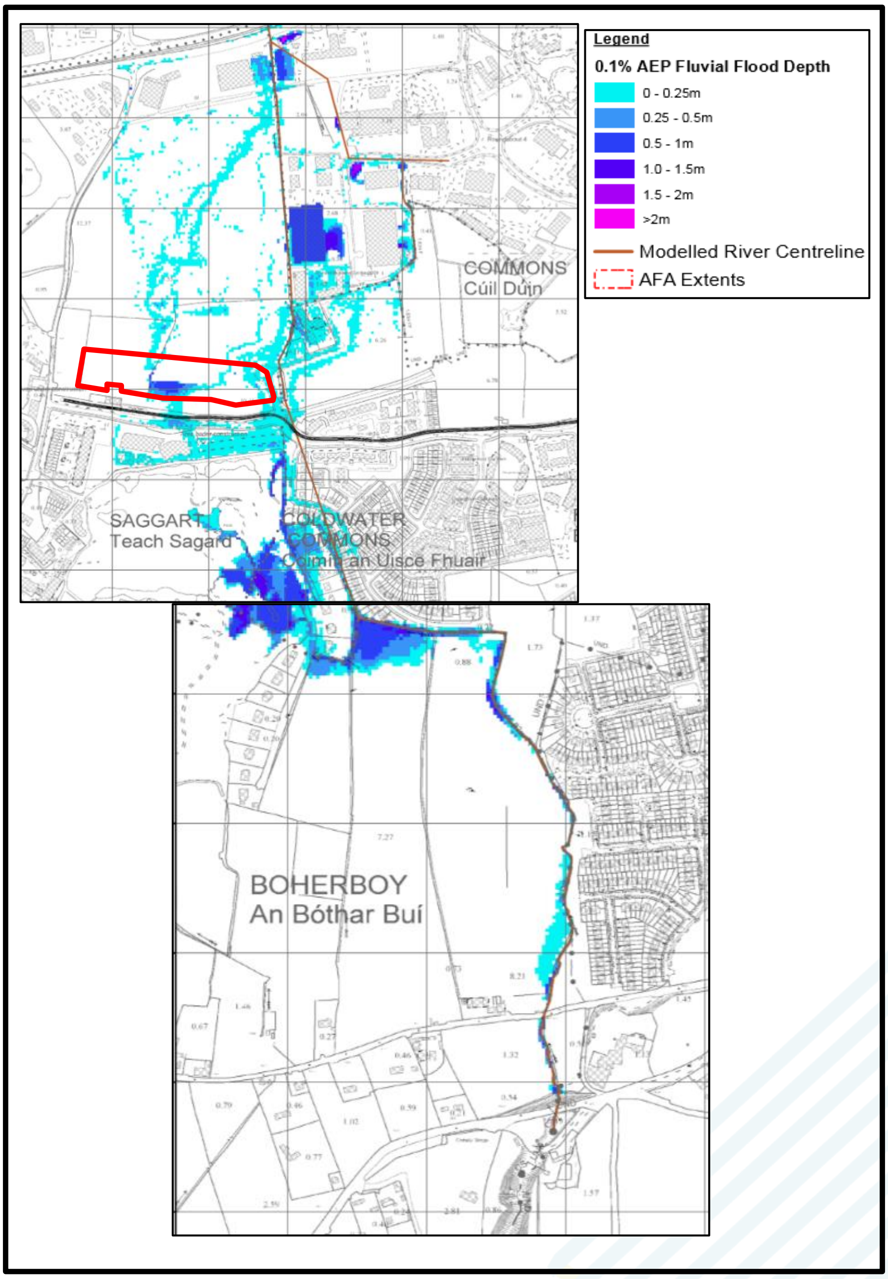


Figure 3-6: 0.1% AEP Fluvial Flood Depths

3.2.2.4 CFRAM Preliminary Options Report (POR)

The preliminary options report outlines defence options for the Camac Catchment. Figure 3-7 identifies properties at risk to flooding. It is noted that the flood extents within Figure 3-7 do not correspond with the flood extents provided in the final CFRAM flood mapping. It is not understood how or why the flood extents are different between the 2 CFRAM reports, though it is presumed that the POR mapping is based on outdated draft mapping.

Figure 3-8 shows two mitigation options relevant to the site location. Walls were proposed upstream from the site where 1% AEP residential flooding was identified. The proposed wall would benefit an area of residential properties south of the site. A second smaller wall was proposed on the east boundary of the site. If these mitigation measures were applied to the final CFRAM flood mapping, all flow paths across the site would be contained within the area benefitting from defences. This shows that a relatively low cost solution could provide significant benefit to flood affected areas.

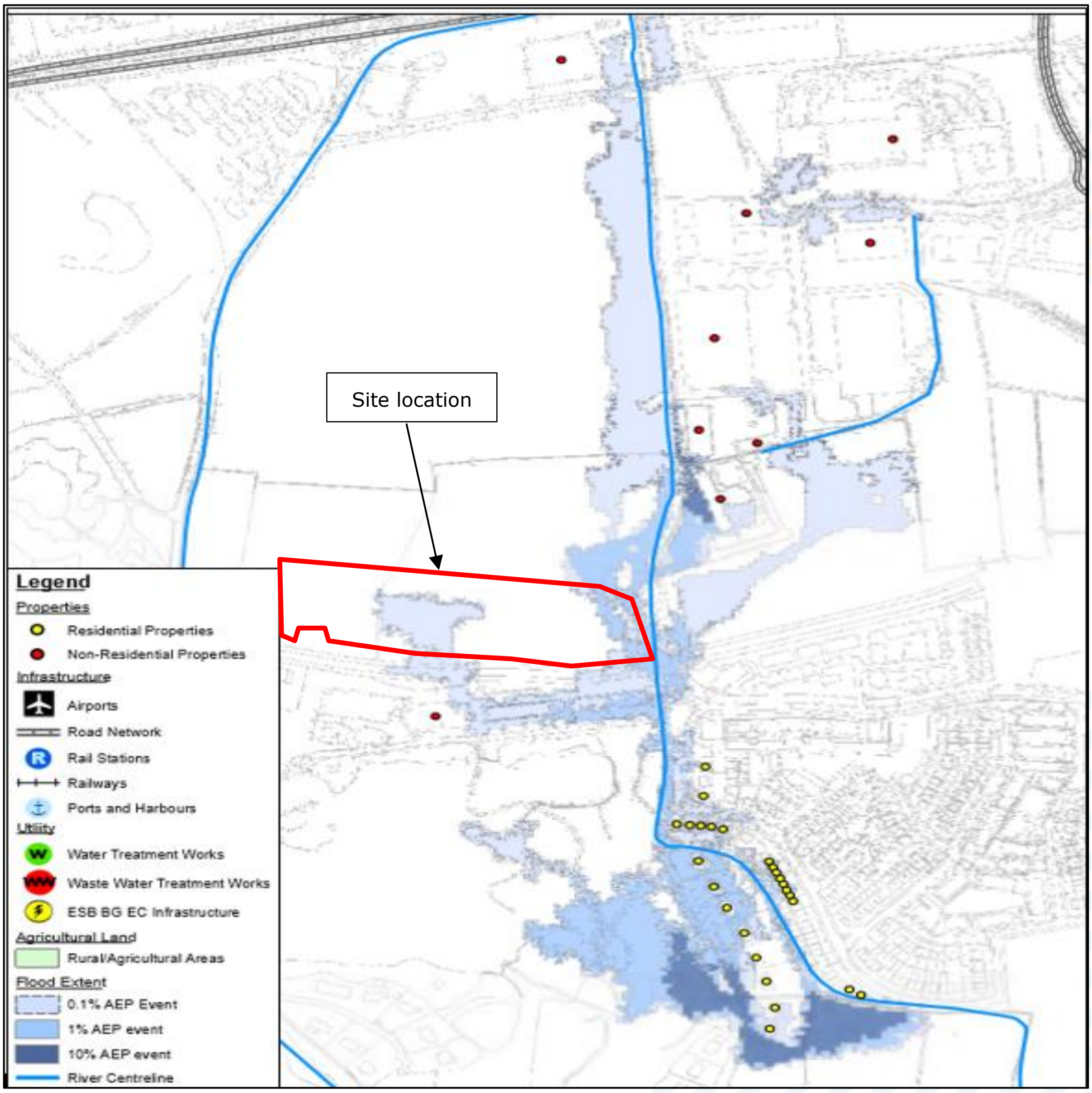


Figure 3-7: Flood Risk Mapping

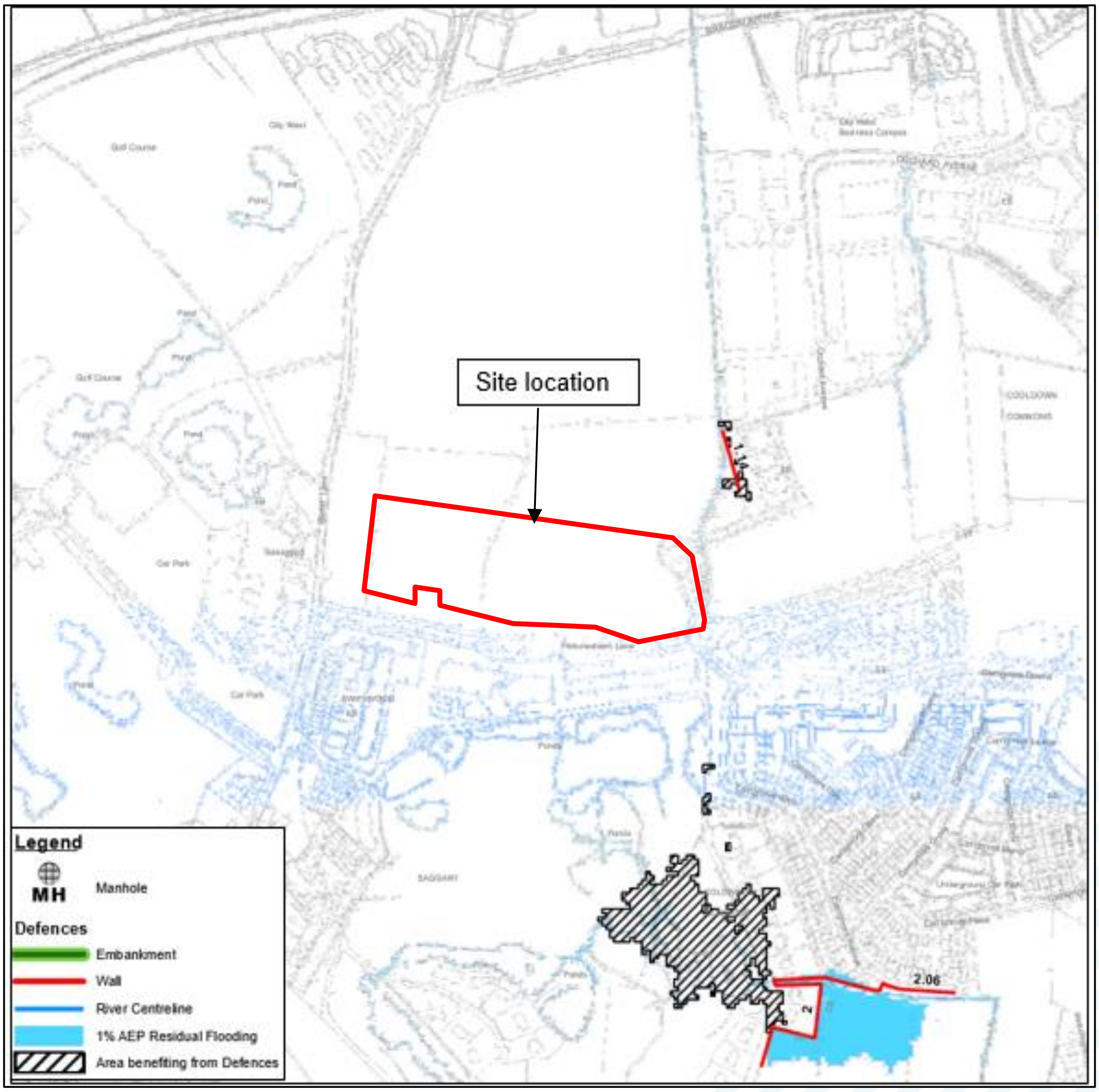


Figure 3-8: Proposed Defence options and benefitting areas

3.2.3 Predictive Flooding Summary

- Qmed estimations were adjusted based on a total catchment-scale analysis, which may not be appropriate for an isolated sub-catchment assessment.
- CFRAM IH124 values could not be replicated with or without the calibration adjustment
- A revised growth curve was adopted for catchments less than 10km^2 based on the assessment of 54 such catchments.
- There is significant storage and attenuation occurring in the former golf course upstream of the site
- Several temporary soil stockpiles are located on site resulting in unrepresentative deeper ponding locations
- CFRAM mapping has filtered very shallow depths across the site resulting in isolated puddles (sometimes a single pixel). It is reasonable to assume that these puddle spots are not a realistic representation of flood risk on the site. These would be considered ponding of surface water, rather than a floodplain.
- The site would benefit from relatively low cost mitigation measures upstream.

3.3 Sources of Flooding

The initial stage of Flood Risk Assessment requires the identification and consideration of probable sources of flooding. These sources are described below

3.3.1 Fluvial

The Eastern CFRAM flood maps, hydraulic and hydrology reports predict shallow fluvial flooding across the site. The predicted flooding is primarily a result in the exceedance of capacity of a culvert much further upstream from the site. Historical observations acknowledge the occurrence of flooding at Fortunestown Road resulting from this overland flow path. As such, the site is not a natural floodplain and is only subjected to fluvial flooding because of undersized drainage infrastructure upstream of the site. Resulting sheet flow across the site remains shallow and disjointed.

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. The OPW PFRA mapping does not indicate any potential pluvial flood risk on the site. The surface water for the site will be connected to the surface water system designed for phase one of the development that has already been granted planning permission with surface water attenuation and storage for up to the 1% AEP event for phase one and future development of phase two (the subject site). This surface water storage system has been designed to store water up to the 1% AEP event plus an allowance of 10% for climate change. The surface water drainage network approved for phase one is designed to accommodate unattenuated surface flows from the phase two site (subject site). Surface water storage for both phases has been designed in the form of two detention basins and the provision of a controlled discharge to a watercourse. Refer to Figure 3-9 for the drainage design for the proposed development site.

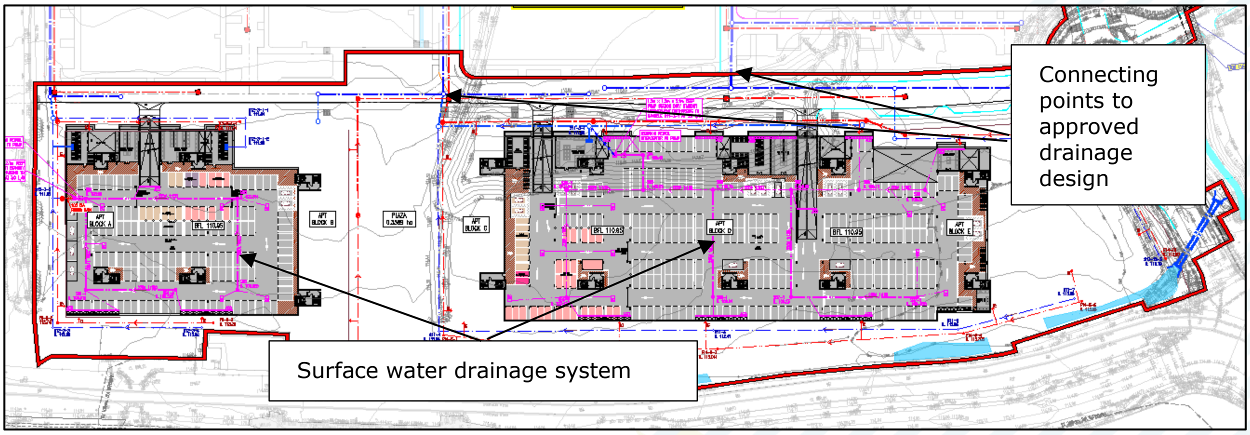


Figure 3-9: Proposed drainage design

3.3.3 Coastal

The site is located near the foothills of the Wicklow Mountains. Coastal flooding is not considered a source of flood risk to the site.

3.3.4 Groundwater

The OPW PFRA mapping does not indicate any groundwater flooding at the site or surrounding area. The GSI groundwater vulnerability for the site is classified as low. Furthermore, there are no karst features in the area which would indicate areas at risk of groundwater flooding. There is no known risk of groundwater flooding in this area, therefore groundwater should not be considered as a likely source of flood risk to the site.

4 Flood Risk Assessment

The CFRAM flood mapping of the Camac catchment provides the most recent assessment of flood risk to the site, with draft mapping incorporated into the SDCC SFRA to inform development of flood zones and appropriate development.

As the estimation of hydrologic flows for the site location could not be verified from the CFRAM report, a hydrologic analysis was undertaken using all available hydrologic methods to appropriately determine flow at the site.

Due to the substantial volume of overland flow resulting from the exceedance in capacity of a culvert far upstream of the site, it appears from the CFRAM flood mapping that Vershoyles Stream downstream of Fortunestown Road is not flowing bankfull during flood events and that due to existing topography, the overland flow paths are not able to return to the stream downstream of Fortunestown Road, resulting in shallow sheet flow across the site and flooding of adjacent properties.

Hydraulic modelling was undertaken to assess under the phase 1 approved application the channel capacity of the existing condition of Vershoyles Stream adjacent to the site.

The following sections will detail the process of flow estimation, hydraulic modelling and present results.

4.1 Hydrology

The hydrologic inflows in terms of annual exceedance probability were derived for the site. This allowed the calculation of flow rates that were used within the hydraulic model. Figure 4-1 shows the catchment area for the site location and identifies the flood estimation point used to estimate flows.

Flow estimation for the catchment was completing using the following methods:

- Flood Studies Update (FSU)
- Flood Studies Report (FSR)
- Flood Studies Report Rainfall-Runoff (FSR RR)
- Institute of Hydrology Report no. 124 (IH124)

All approaches required the input of various hydrological variables specific to the site which were calculated using a digitised version of the original FSU portal and the FSR maps.

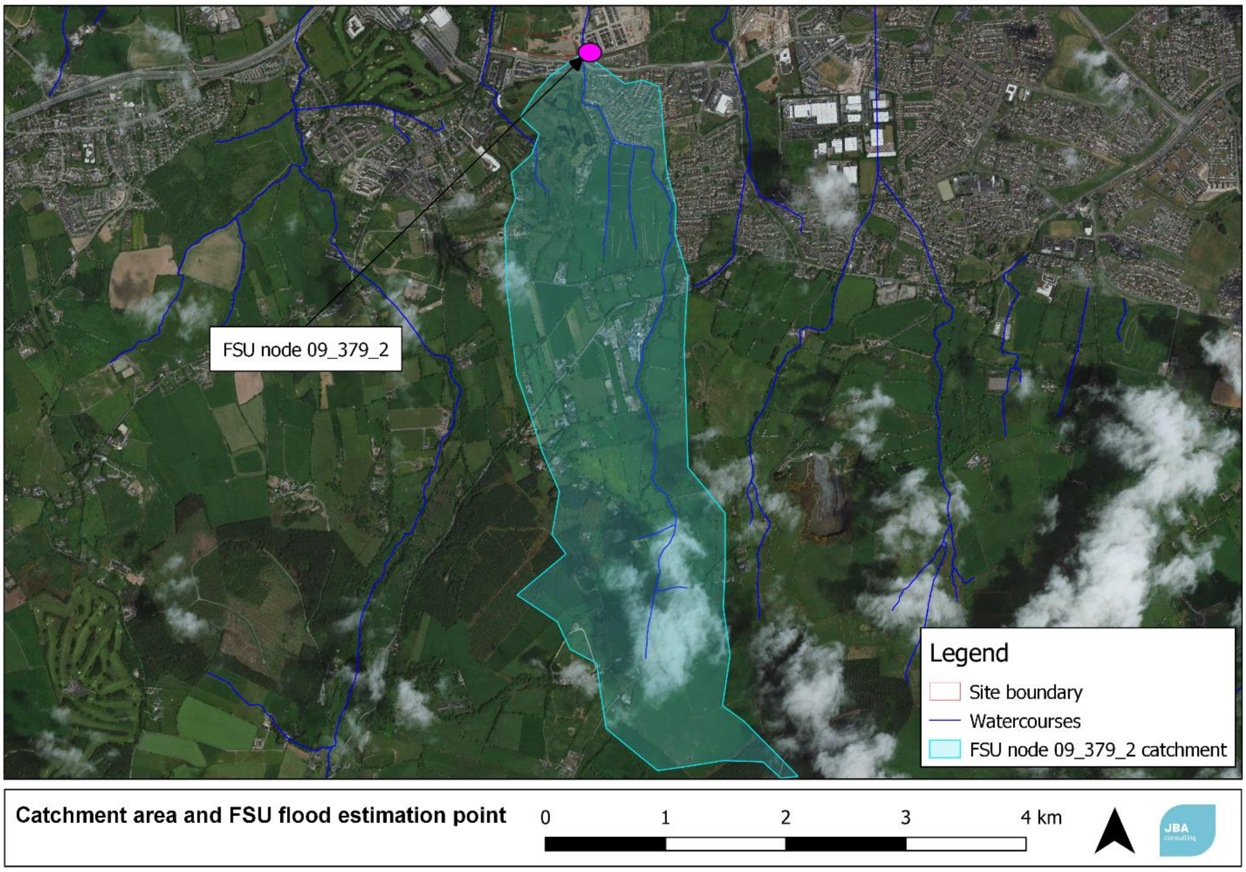


Figure 4-1: Catchment area and FSU flood estimation point

Each hydrology method was assessed independently to determine the best available estimate of peak flows, though all methods remain subject to uncertainty. The FSU estimation points used are reflective of the catchment as a whole and allowed for a conservative assessment of the hydrology as they do not include for any storage or attenuation within the catchment.

The IH124 method was chosen as the preferred method for the purposes of this assessment as it is the best method to represent smaller catchment areas. This is consistent with the ECFRAM approach. The values derived for the IH124 method were found to be higher than those represented in the ECFRAM values. Whilst the methodology was consistent, the IH124 flows calculations reported within the CFRAM study were unable to be validated either before, or after the adjustments made through calibration at the Killeen Road gauge. Therefore, the CFRAM determined flows have not been used in this assessment. However, the growth curve produced from the CFRAM study is preferred as the IH124 method uses a derived generalised curve for the entire country, whereas the ECFRAM assessment derived a growth curve for all node points within the ECFRAM area with a catchment area less than $10km^2$. The growth curve determined within ECFRAM is applied to the IH124 Qmed determined in this assessment to provide the best estimate of flows for the study site catchment.

Table 4-1 outlines the derived flows for the FSU estimation point at the site location.

Table 4-1: Estimated Peak Flows

Annual Exceedance Probability (AEP)	CRFAM Growth Factor	09_376_2 Flow (m3/s)
50%	1	1.32
20%	1.45	1.92
10%	1.80	2.37
5%	2.18	2.89
2%	2.78	3.67
1%	3.32	4.39
0.1%	5.93	7.82

4.2 Hydraulic Modelling

A hydraulic model was developed to appropriately assess conveyance within Vershoyles Stream downstream of Fortunestown Road. The CFRAM mapping indicates fluvial flooding at the site location is the result of a culvert far upstream of the site and that no overtopping of Vershoyles Stream occurs downstream of Fortunestown Road. Predicted overland flow paths do not currently return to Vershoyles Stream. The hydraulic model was used to inform the mitigation measures required if the total unattenuated catchment flow is contained within the drainage network upstream of the site.

4.2.1 Hydraulic Modelling Overview

The hydraulic model was completed using TUFLOW-ESTRY software. TUFLOW is a comparable commercial product to Infoworks ICM and Mike Flood.

TUFLOW is specifically oriented towards establishing flow and inundation patterns in floodplains and urban areas where the flow behaviour is essentially two-dimensional in nature and cannot appropriately be represented within a one-dimensional model. TUFLOW can dynamically link to 1D networks using the hydrodynamic solutions of ESTRY or ISIS. This model has been refined by modelling the open stream and inline structures using ESTRY.

The hydraulic model was carried out in the following stages:

- A new 1D-2D ESTRY-TUFLOW model of the site location and Vershoyles Stream running along the east boundary of the site was created using river data surveyed and on-site observations.
- Design simulations were run to simulate the ECFRAM 1% AEP and 0.1% AEP flood events.

Figure 4-2 represents the river channel on the east boundary of the site. The arrows represent the open channel flow, weirs and culverts running parallel to the study site.

This assessment applies the full hydrologically ECFRAM determined flows at the downstream outlet of the Fortunestown Road culvert, producing a highly conservative application of the flow in the stream. This approach does not incorporate any of the attenuation or storage upstream of the site in the former golf course. The ECFRAMS hydraulic report estimates that storage and attenuation in the Vershoyles Stream catchment results in a decrease in peak flow of 38% in the 1% AEP flow event.

Assessment of residual risk including blockage at key structures and allowance for climate change have also been considered.

Bianconi Avenue forms the downstream boundary of the model where overland flow leaves the model under normal flow conditions and the rectangular culvert under Bianconi Avenue has been assigned a flow-stage relationship based on the conveyance properties of the culvert.

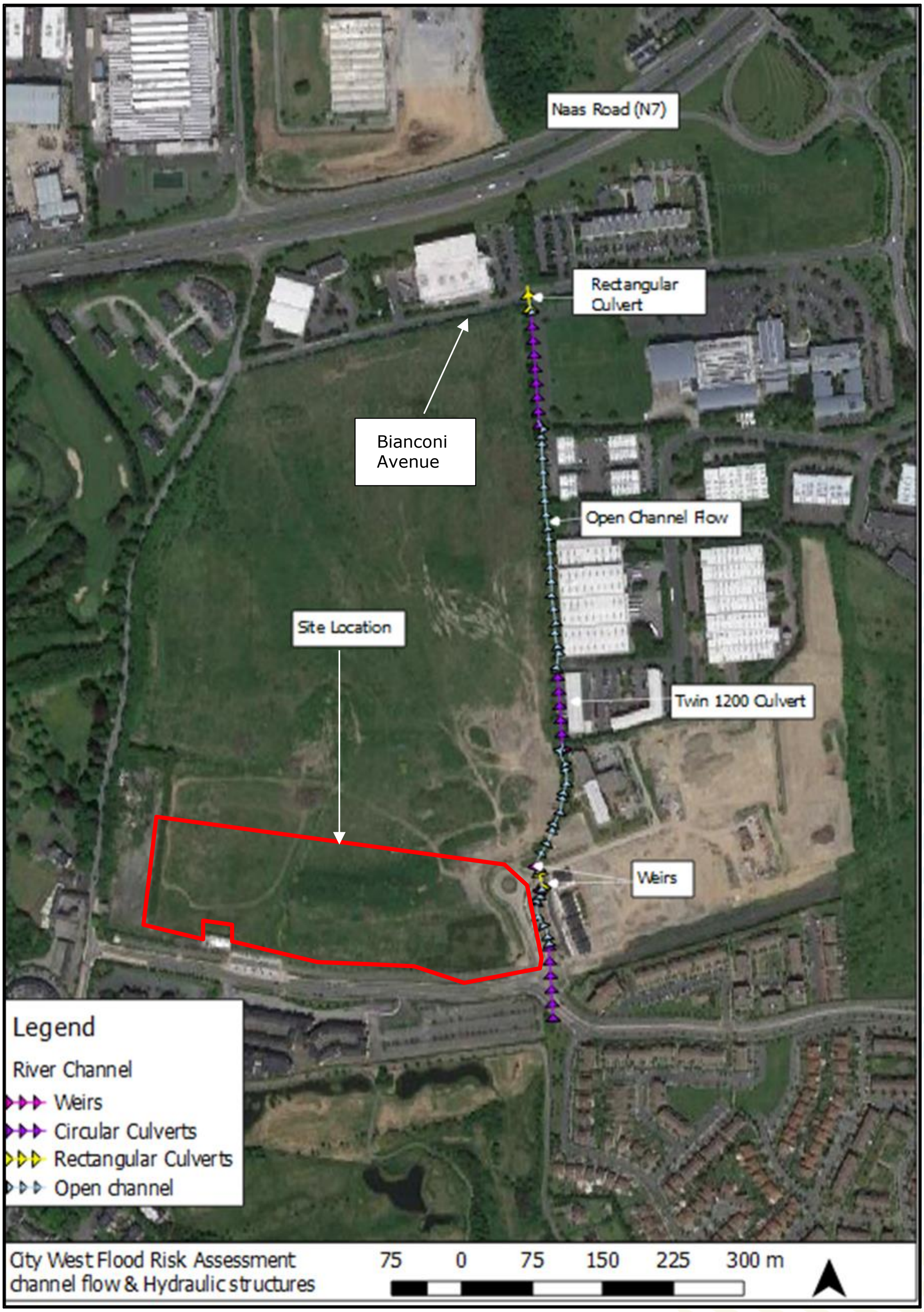


Figure 4-2: Existing channel conditions

4.2.2 Results

The results from the hydraulic modelling for the 1% and 0.1% AEP flood events are presented in Figure 4-3 and Figure 4-4. Inundation occurs onsite during both flood events. The flood flow pathways and extents are similar to the ECFRAM flood outlines which are presented in Figure 4-3.

As per the ECFRAM mapping, the main cause of inundation onsite results from the ingress of overland flows along the southern boundary of the site. The main flow pathway traverses the site from the site centre at the southern boundary, through the site to the north-eastern corner. Flows are shallow during both flood events with depths predominantly less than 250mm. Greater flood extents are recorded during the 0.1% AEP flood event.

The mapping shows flooding on the east boundary along Vershoyles Stream at the Fortunestown Road culvert system and at the twin 1200mm circular culverts where out of channel spill occurs. The hydraulic model boundary does not include the adjacent industrial buildings; therefore, depth mapping is intended to be considered at this location. There is also shallow overland flow across Bianconi Avenue.

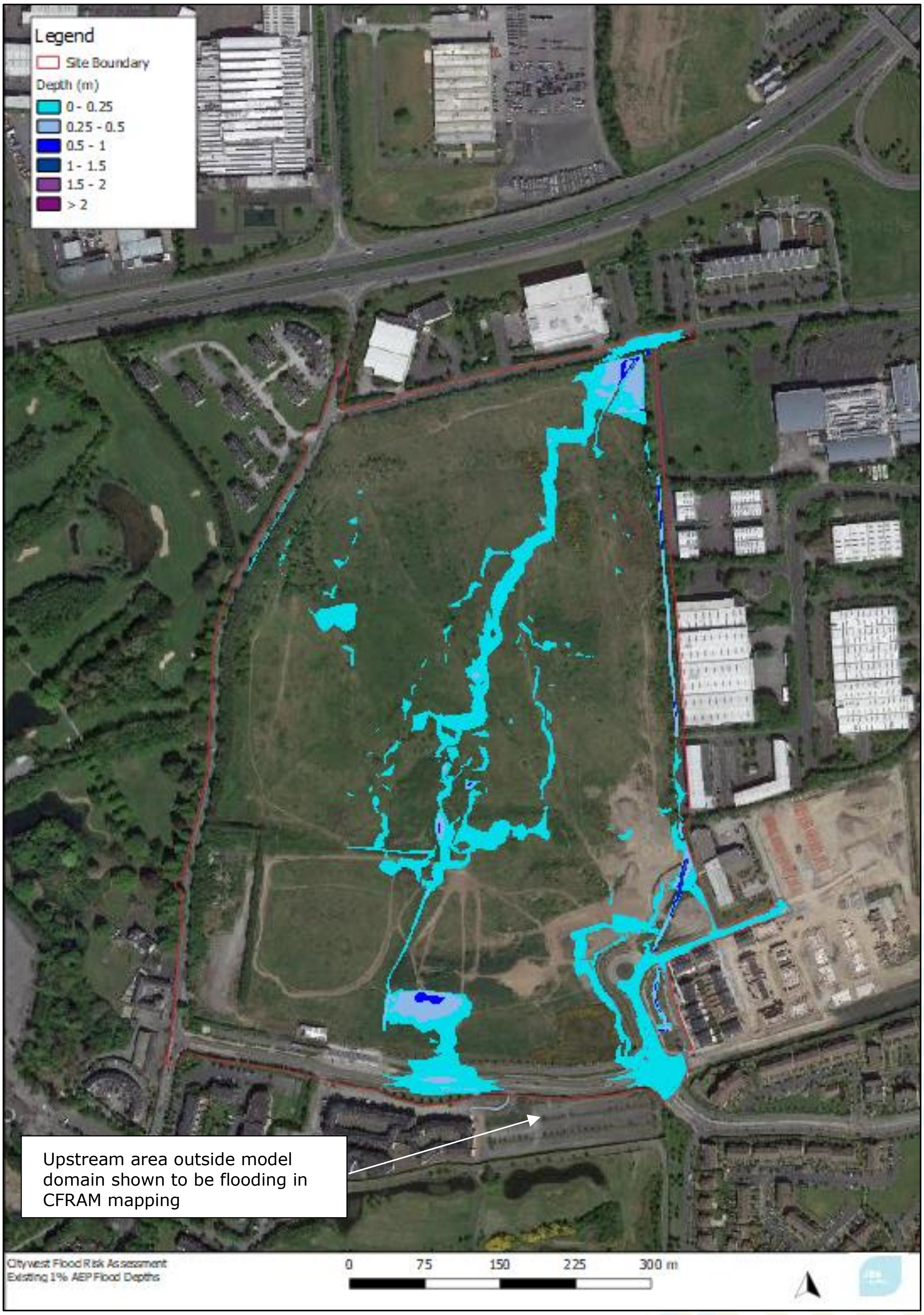


Figure 4-3: Existing 1% AEP flood risk

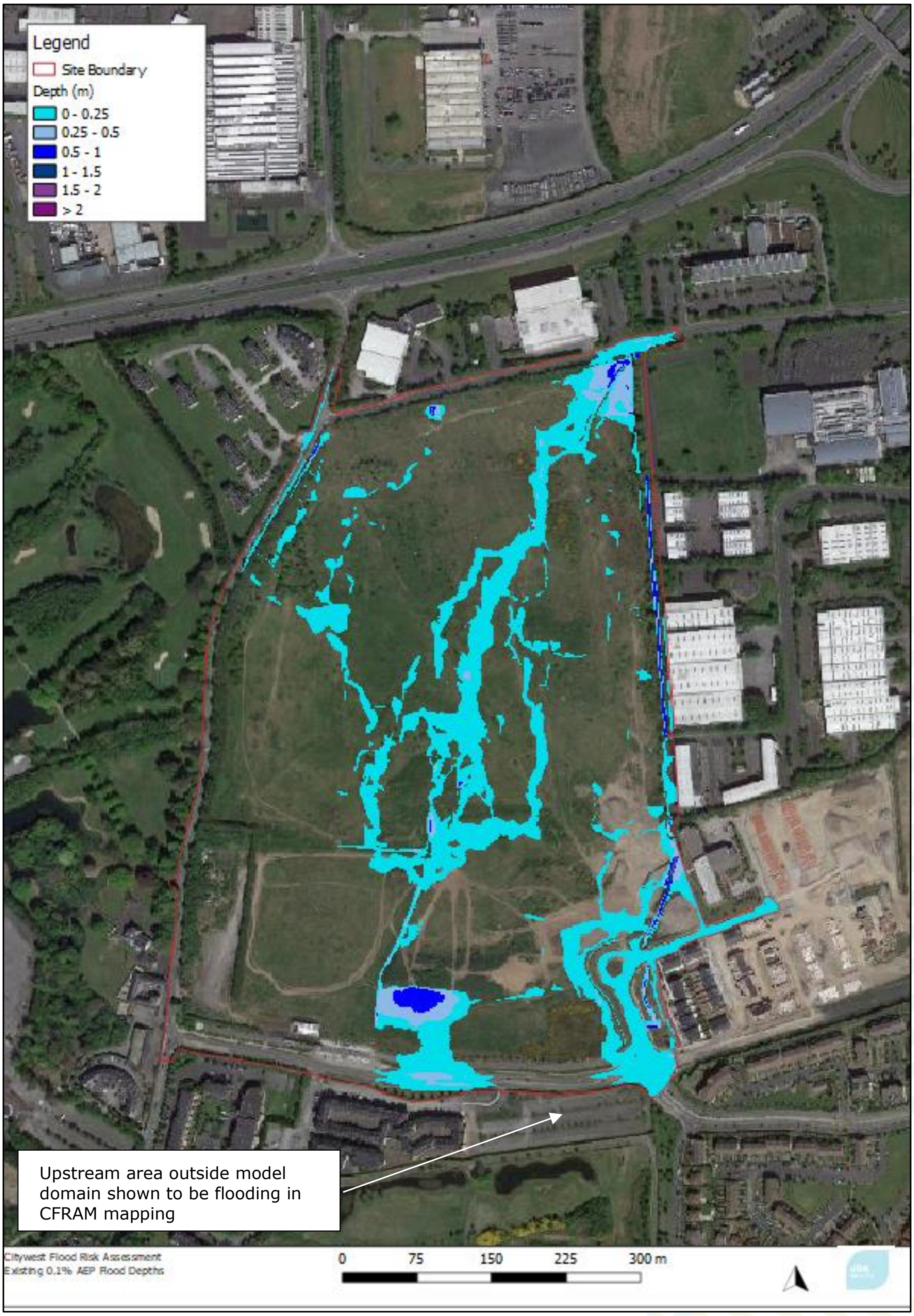


Figure 4-4: Existing 0.1% AEP flood risk

4.3 Diversion Channel / Flood Conveyance Channel

To manage inundation of the site, it is proposed that an open channel drain is placed across part of the southern boundary of the site running parallel to Fortunestown Road. This swale will redirect shallow flows across the site back into Vershoyles Stream. This uniform channel of 4m width was modelled and approved under the Phase 1 development. This application proposes modifications to the approved channel in keeping with the proposed development of the site and the associated landscape proposals. The modifications include providing a channel of varying widths which are demonstrated in dwg 162073-3200. The hydraulic model created for the Phase 1 development has been updated to reflect the changes proposed to the flood conveyance channel.

Additional measures that have already been approved as part of the phase one planning application for the development area included modification to the existing link road to Fortunestown Lane to channel overland flow back into the Vershoyles Stream. Some re-grading of the Vershoyles Stream has been carried out between the Fortunestown Road junction and the Twin culvert system. The purpose of the outlined mitigation measures is to ensure that no overtopping occurs onto the proposed development during the 1% & 0.1% AEP flood events.

A hydraulic model was developed to test the effectiveness of the channel during both the 1% & 0.1% AEP flood events. The results are depicted in Figure 4-5, which confirms that the proposed channel has sufficient capacity to channel both the 1% and 0.1% AEP flood events around the site and back to the Vershoyles Stream.

Figure 4-6 over page, provides the peak flood levels for the 1% AEP MRFS along the proposed swale and confirm that the development is not at risk of inundation following implantation of the mitigation measures.

The proposed mitigation measures achieve the objective of intercepting all overland flows onto the site. No overland flows are recorded as all flows remain instream. Inundation occurs surrounding the access roadway as per the pre-development scenario. The source of overland flow originating from the south which is intercepted by the modified link road from Fortunestown Lane and channelled instream.

Figure 4-5: Post Development- 1% AEP & 0.1% AEP Flood Extent

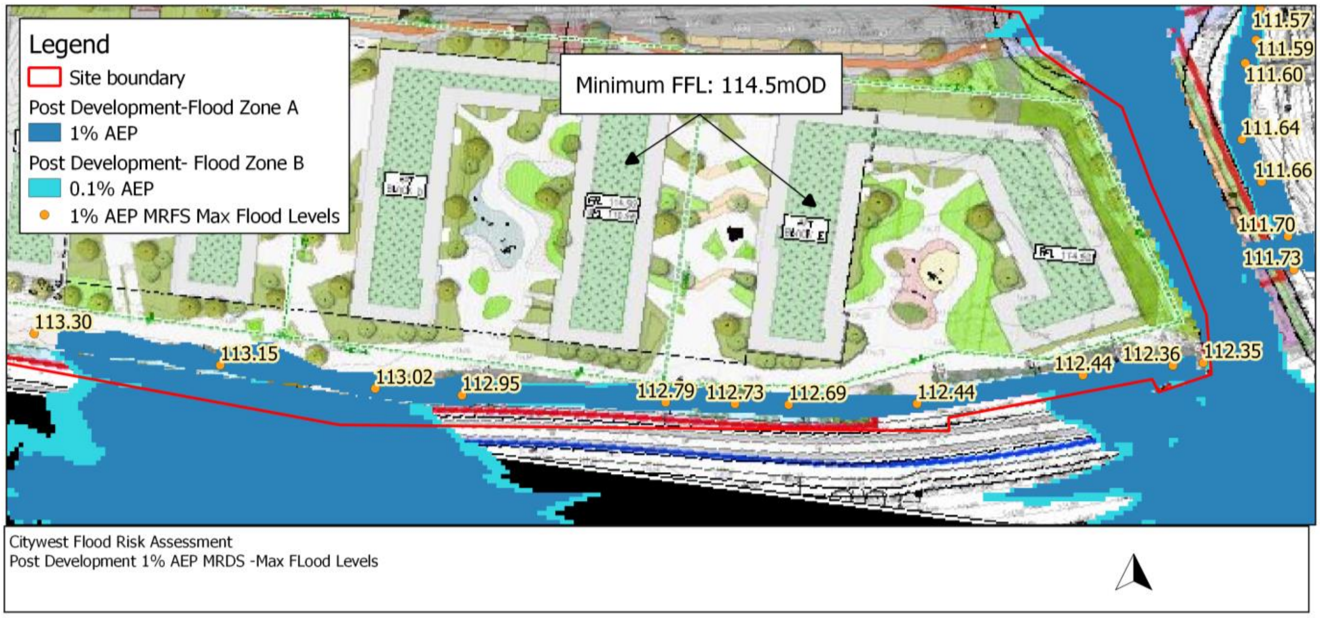


Figure 4-6: Post Development- 1% AEP MRFS Peak Flood Levels

5 Flood Risk Mitigation

5.1 Overland flow swale

Mitigation measures have been developed in response to the risks previously discussed. As outlined in Section 4.3, it is proposed that an open channel drain is placed across the top of the site running parallel to Fortunestown Road. This channel will redirect shallow flows across the site back into Vershoyles Stream. A landscaped channel of variable width (1.7-4m) with sloped sides which has the capacity to intercept shallow flows across the site for events up to and including the 0.1% AEP event and includes a 300mm freeboard within the channel.

5.2 Site layout, landscaping and finished floor levels

Assessment of channel capacity within Vershoyles Stream concludes the stream has the capacity to contain the 1% AEP flow with an allowance for climate change. The urban storm water drainage will discharge to the stream, and will form an important constraint for flood levels within this flat site. The minimum finished floor level proposed is 114.5mOD, the peak water level for within the overland flow swale in the 1% AEP plus climate change scenario is 113.30mOD, refer to Figure 4-6. Therefore, there is freeboard of 1.2m provided in the design scenario.

5.3 Access and Egress

Access and Egress to the site will be provided via the existing roundabout off Fortunestown Road and there are additional two access points from Garter Lane (approved and currently under construction) which are not at risk of flooding. CFRAM mapping identifies shallow flow over the road in the 1% AEP and 0.1% AEP events from overland flow crossing Fortunestown Road. Re-design of road levels and inclusion of the on-site open channel will reduce the risk of shallow flows over the road. The entrance to the development from Fortunestown Lane at the south east corner of the site is at risk from the 1% AEP and 0.1% AEP flood events. Flood depths are shallow at <0.1m. Therefore, access and egress will not be impeded during these flood events.

5.4 Drainage Design

The drainage system has been assessed for 30 and 100-year return period events for a full range of storm events with no out of system flooding, i.e. designed to surcharge within the system up to 100% AEP event. A climate change factor of 10% has been incorporated into the stormwater calculations. Refer to Figure 3-9 for the proposed stormwater system.

5.5 Residual Risk

Increasing 1% AEP flows by 20% to include an allowance for climate change Medium Range Future Scenario (MRFS) would increase the peak 1% AEP flow to 5.26m^3/s. The channel capacity assessment identifies the twin 1200mm culvert north of the site's eastern boundary as the hydraulic control within the existing drainage network with a flow capacity of approximately 6.1m^3/s. The culvert can convey both the 1% & 0.1% AEP flood events without surcharging. The peak flow rate thought the culvert during the 1% AEP event is 2.15m^3/s, therefore the culvert has sufficient capacity to convey the 1% AEP flood event during a 50% blockage scenario.

To minimise the risk of blockage, it is recommended that a management plan be devised as part of the overall development's maintenance programme to visually check for blockage and clear any debris within the flood conveyance channel and connecting culverts if required.

It is suggested that raised entry treatments are located at ramp access to the basements to prevent overland flow. It is also recommended that vent locations for the basements on the southern faces of the proposed buildings are placed at a level above the 0.1% AEP peak water level within the channel (113.53mOD) and an additional 300mm freeboard applied. The recommended vent minimum vent height for the southern face is therefore 113.83mOD.

The proposed vents located on the northern faces are not at risk of inundation and therefore can be set at a lower level, there are no vents proposed on the east or west faces.

5.6 Impacts on flood risk through the development

As shown in the hydraulic modelling, there is no impact to flood risk in the 1% AEP as the existing channel and structures have the capacity to contain the 1% AEP flow including allowance for climate change.

5.7 Justification Test

The proposed buildings lie within A/B. As the development encroaches into Flood Zone A/B, the Justification Test for Development Management has been applied and passed:

• The Fortunestown Local Area Plan 2012-2017 (as a constituent of the South Dublin County Development Plan 2016-2022) has provided a zoning for this site as an area ' to provide for new residential communities in accordance with approved Area Plan. The zoning and designation of the overall site demonstrates that the development complies with Section 1 of the Justification Test.

• The Proposal has been subject to an appropriate flood risk assessment which shows:

i. The Development will not significantly increase flood risk elsewhere

ii. The development (building FFL) is raised above the 1% AEP event including climate change and freeboard to minimise the risk to people and property as far as is possible. Flood flows are managed by an open channel drain diversion which routes any overland flows around the site in channel.

iii. Residual risk is managed by the setting of appropriate finished floor levels, building placement and landscaping on site. Improvements to the culvert entrance will improve the hydraulics and reduce the residual risk.

iv. The development meets the standards of typical residential development design.

The mitigation strategy comprises of the construction of a flood conveyance channel through the subject site. This application proposes modifications to the channel to ensure that it is in keeping with the development strategy for the site.

6 Conclusion

This Flood Risk Assessment has comprehensively reviewed existing flood risk to the site and predictive flood studies, specifically the ECFRAM study. This assessment has shown that overland flow paths affecting the site in the 1% and 0.1% AEP events are caused by the exceedance in capacity of a culvert approximately upstream of the site.

These overland flow paths have limited ability to return to Vershoyles Stream due to the existing topography. However, as part of this Flood Risk Assessment a review of the capacity downstream of Fortunestown Road has shown Vershoyles Stream can convey the full un-attenuated flow in the 1% AEP event including an allowance for climate change, should the culvert restrictions be removed in the future.

Capacity of a twin 1200mm culvert on the upstream of the eastern boundary of the site is exceeded in the 0.1% AEP event for the existing scenario. Mitigation measures to re-grade the channel upstream from the culvert and provide a new trash screen have been approved as part of the phase one planning application. The existing flood risk with flows are contained in the proposed design scenario contained in channel for the 1% and 0.1% AEP flood event post-development.

The proposed mitigation strategy relates to the subject site and the Phase 1 development site under construction (approved under the ABP 300555-18). The mitigation strategy would remove flood risk from the site by returning overland flow paths to Vershoyles Stream via an open channel drain (flood conveyance channel). The channel capacity assessment shows that flow for the 1% AEP MRFS and 0.1% AEP events remains in channel without increasing flood risk to the site or adjacent properties. The proposed mitigation measures also shows that the Vershoyles Stream downstream of Fortunestown Road has the capacity to convey the full 1% AEP MRFS flow without the inclusion for any attenuation upstream. Management of flood risk of the site up to the 0.1% AEP event would be addressed by the open channel drain and any changes upstream would not impact on the development flood risk as the channel has a flexible capacity.

The minimum Finish Floor Level (FFL) proposed for the development is 114.5mOD. Review of the post-development flood levels provide a maximum 1% AEP MRFS of 113.3mOD which confirms that a minimum freeboard of 1.20mOD is provided for in the proposed design over the 1% plus climate change event and a freeboard of 0.97m over the 0.1% AEP event.

Residual risks to the site have been identified to occur from a potential blockage of the twin culvert system downstream of the subject site and the potential increase in stream flow due to climate change. The 1% AEP MFRS confirms that the proposed flood conveyance channel and existing twin culvert system downstream have sufficient capacity to contain this flood event. Although the twin culvert system can convey flood waters during a 50% blockage event, a blockage greater than 50% could result in overtopping of the culvert system. Overtopping of the culverts could lead to localised flooding directly upstream of the culvert system, but the extents would be reduced from those seen in Figure 4-4 due to the proposed design features. A blockage of greater than 50% is a worst-case scenario event and unlikely to occur as the culverts are within a maintained system. To protect against this residual risk it is recommended that frequent visual inspections of the culvert be undertaken and debris removed as required as part of the wider maintenance programme.

A stormwater system is included as part of the development to manage surface water runoff. The proposals for the site limits the discharge rate to its greenfield equivalent. Stormwater attenuation is provided which is designed to contain the capacity for a 1% (1 in 100 year) storm event plus an allowance for climate change.

The proposed mitigation measures do not result in an increased flood risk to surrounding properties but will reduce flood risk. The post-development residential area is outside of Flood Zone A/B. The development has passed the Justification test for residential development.

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.

Appendices

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: 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

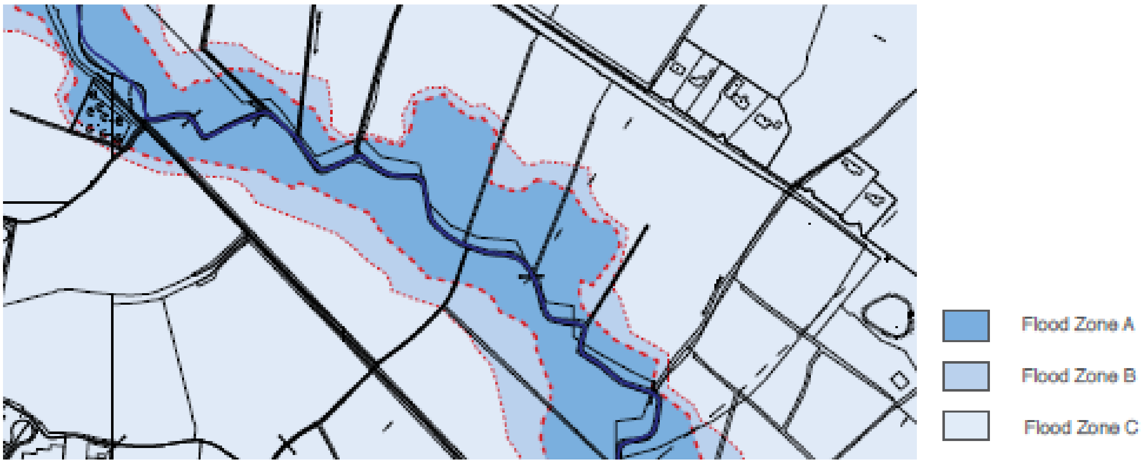
A.2 Flood Zones

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.

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.

Indicative Flood Zones (OPW & DoEHLG 2009)



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.

JBA consulting

Offices at

Dublin
Limerick

Registered Office
24 Grove Island
Corbally
Limerick
Ireland

+353(0)61 345463
info@jbaconsulting.ie
www.jbaconsulting.ie
Follow us:

JBA Consulting Engineers and Scientists Limited

Registration number 444752

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007