Waterman Moylan
Engineering Consultants

Flood Risk Assessment

Proposed Strategic Housing Development at Fosterstown North, Dublin Road / R132, Swords, Co. Dublin

April 2022

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

Issue	Date	Prepared by	Checked by	Approved by
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Comments

Disclaimer

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1. Introduction

This Flood Risk Assessment (FRA) has been prepared by Waterman Moylan as part of the documentation in support of a planning submission to An Bord Pleanala for the construction of a strategic housing development at lands at Fosterstown North, Dublin Road / R132Swords, Co. Dublin.

This report has been prepared as part of a Strategic Housing Development planning submission to An Bord Pleanála, for the proposed development which will consist of 645no. residential units (comprising of 208no. 1-bedroom units, 410no. 2-bedroom units, and 27no. 3-bedroom units), in 10no. apartment blocks, with heights ranging from 4no. storeys to 10no. storeys, including undercroft / basement levels (for 6no. blocks). The proposals include 1no. community facility in Block 1, 1no. childcare facility in Block 3, and 5no. commercial units (for Class 1-Shop, or Class 2- Office / Professional Services or Class 11- Gym or Restaurant / Café use, including ancillary takeaway use) in Blocks 4 and 8. The proposal includes all associated and ancillary development.

This FRA has been carried out out in accordance with the Department of Housing and Local Government (DEHLG) and the Office of Public Works (OPW) document *"The Planning Process and Flood Risk Management Guidelines for Planning Authorities"* published in November 2009. The Strategic Flood Risk assessment prepared by Roughan O'Donovan as part of the Fosterstown Masterplan in May 2019 has also been reviewed. This Assessment identifies and sets out possible mitigation measures against potential risks of flooding from various sources. Sources of possible flooding include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical error.

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

2. Site Description

2.1 Site Location

The site is located in Fosterstown North, Swords, Co. Dublin and is bound to the north by a greenfield site which forms the northern portion of the Masterplan Lands, to the east by the R132 and to the south and west by the Boroimhe residential development. The subject site is located 2km north of Dublin Airport and 1km south of Swords Main Street.

Refer to Figure 2-1 for the location of the proposed development.

Figure 2-1: Site Location (image taken from Google Maps)

2.2 Existing Development

The total area for the proposed development works is approximately 4.635 hectares and is currently greenfield. The site falls from the existing high point in the southwest corner with a level of 47.88m OD Malin to the low point in the northeast corner of the site with a level of 36.75m OD Malin. The site slopes sharply to the northeast with an average slope of 1:34. There is an existing watercourse (Gaybrook Stream) along the entirety of the northern boundary of the site which flows from west to east. The site is currently accessed by a gate from the R132/Dublin Road.

Refer to Figure 2-2 for the map of the existing site topography.

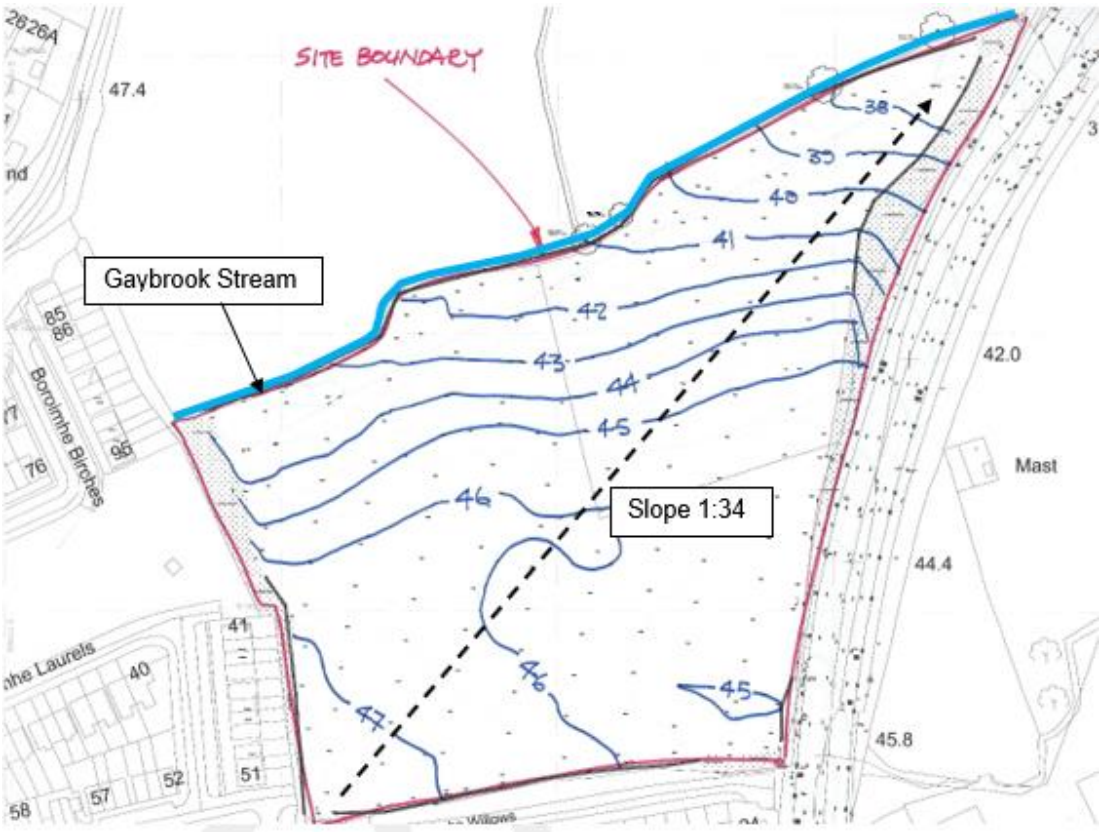


Figure 2-2: Subject Site Topography

2.3 Proposed Development

The proposed development comprises a Strategic Housing Development of 645№ residential units (comprising of 208№ 1 bedroom units, 410№ 2 bedroom units, and 27№ 3 bedroom units), in 10№ blocks, with heights ranging from 4№ storeys to 11№ storeys over an undercroft / basement level. The proposals include 1№ community facility in Block 1, 1№ childcare facility in Block 3, and 5№ commercial units (for Class 1-Shop, or Class 2- Office / Professional Services or Class 11 Gym or Restaurant / Café use, including ancillary takeaway use) in Blocks 4 and 8. The proposal includes all associated and ancillary development. Please refer to the public notices for a detailed description of the proposed development. The aspects of key relevance to this report are discussed in preceding sections.

3. Flood Risk

3.1 Introduction

The components to be considered in the identification and assessment of flood risk are set out in Table A1 of the DEHLG/OPW guidelines on the Planning Process and Flood Risk Management and are summarised below:

- Tidal – flooding from high sea levels;
- Fluvial – flooding from water courses;
- Pluvial – flooding from rainfall / surface water;
- Ground Water – flooding from springs / raised ground water and
- Human/mechanical error – flooding due to human or mechanical error.

Each component will be investigated from a source, pathway and receptor perspective and the likelihood of flood occurring and the possible consequences will be assessed.

The likelihood of flooding falls into three categories; low, moderate and high, as described in the OPW Guidelines and set out in Table 2.

Table 3-1 OPW Guidelines

Likelihood	Low	Moderate	High
Tidal	Where probability < 0.1 % chance of occurring in a year	0.5 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 0.5 % chance of occurring in a year
Fluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year
Pluvial	Where probability < 0.1 % chance of occurring in a year	1 % chance of occurring in a year > probability > 0.1 % chance of occurring in a year	Where probability > 1 % chance of occurring in a year

For ground water and human/mechanical error, the limits of probability are not defined and therefore professional judgment is used. However, the likelihood of flooding is still categorised as low, moderate and high for these components. The likelihood and possible consequence of each event is considered, and the risk is evaluated. Risks will be mitigated where possible and the residual risks will then be considered as part of this assessment.

This report has considered the Fingal East Meath Flood Risk Assessment and Management Study (FEM-FRAM) together with the flood maps prepared by Halcrow Barry for Fingal County Council, Meath County Council, and the OPW.

Fosterstown Masterplan

Roughan O'Donovan (ROD) have prepared a Strategic Flood Risk Assessment (SFRA) which forms part of the "Surface Water Management Plan (Appendix C)" of the Fosterstown Masterplan. ROD carried out a three stage SFRA which included modelling of the Gaybrook Stream to assess the Flood Risk on site. The report states that survey data was used to model the river channel and LiDAR data was used to assess the ground levels on the lands of the Masterplan.

The SFRA concluded that the most significant source of flooding within the masterplan area is from fluvial inundation from the Gaybrook Stream. There are also several minor areas of pluvial flooding within the

Masterplan. The risk of development on the proposed development is explored in the following Sections 3.2-3.6.

3.2 Tidal – Irish Sea

Tidal Flooding is caused by elevated sea levels or overtopping by wave action. The Irish Sea is approximately 6 kilometres east of the subject site. The proposed development is to be constructed at a level of between 38.00 m and 47.57 m OD Malin. The entrance to the proposed basement carpark is to be constructed at a level of 46.07 m OD.

The Dublin Coastal Protection Project indicated that the 2002 high tide event reached 2.95 m OD Malin. The entrance to the basement of the subject site is therefore 43.12 m above the highest tide recorded in the Dublin Coastal area and the lowest building floor level is 41.25 m OD Malin above the highest tide.

Given that the site is located 6km inland from the Irish Sea, the site levels exceed the highest ever recorded or projected tide in the area, and that there is no coastal flooding indicated on the OPW map, the risk from tidal flooding is considered extremely low and no flood mitigation measures need to be implemented.

3.3 Fluvial

Fluvial flooding is caused by rivers, watercourses or ditches overflowing. The subject site is surrounded on the northern boundary by Gaybrook Stream, refer to Figure 3-1 for location of Gaybrook Stream and its catchment area (shown in the orange outline).

Figure 3-1: Gaybrook Stream and Catchment area

The FEM FRAM fluvial flood extent map for the Broadmeadow River (BRO/HPW/EXT/CURS/003) dated August 2010, shown in Figure 3-2, indicates the development in the 'current scenario' is not at risk of flooding during a 1 in 100-year or a 1 in 1000-year event.

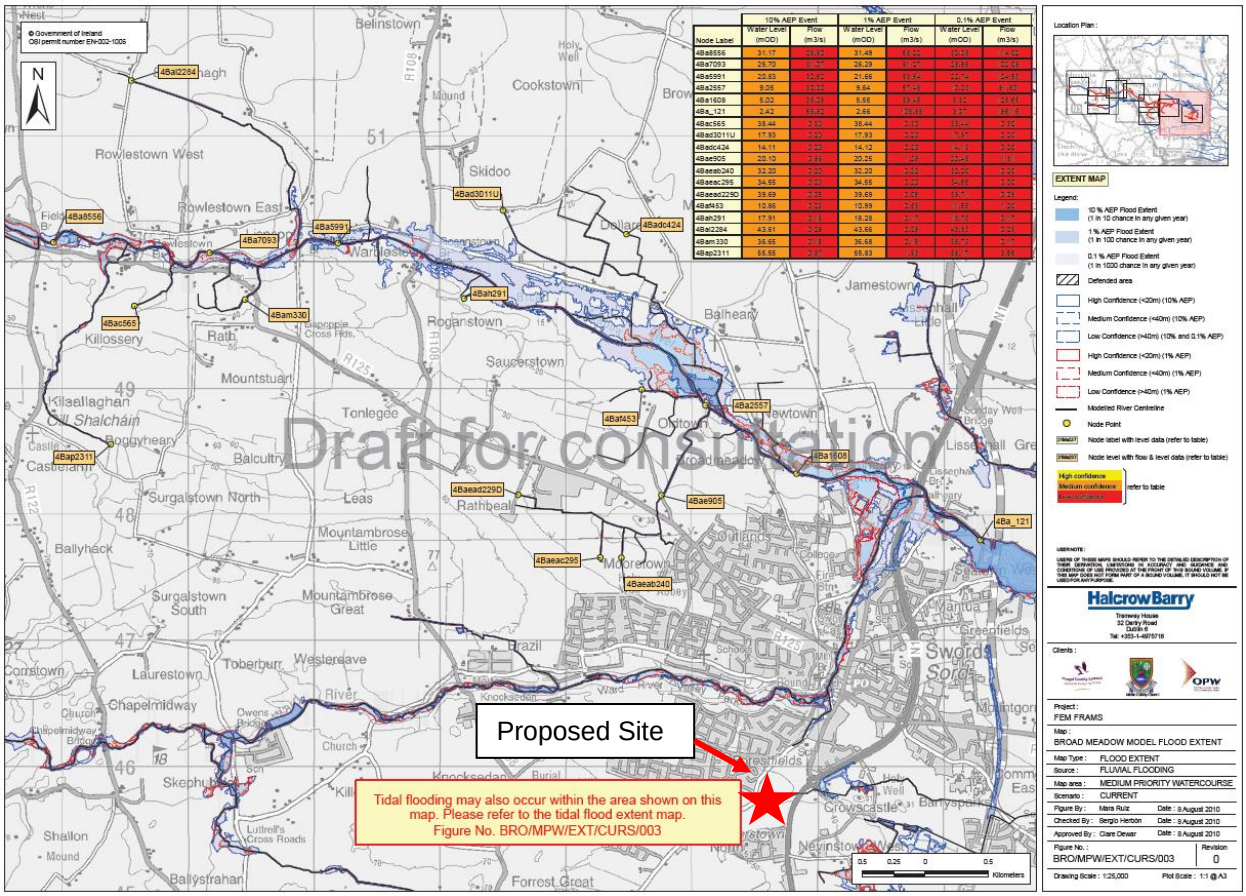


Figure 3-2: Extract from FEM-FRAM 2016 Fluvial Flood Map

However, Stage 3 of the Strategic Flood Risk Assessment for the Fosterstown Masterplan included a hydraulic model to verify the effects of extreme pluvial and fluvial events on the Gaybrook Stream and the results of this hydraulic model show that during extreme events, the downstream culvert under the R132 Dublin Road has insufficient capacity. As a result, a small portion of the subject site to the northeast is at risk of flooding during extreme fluvial events. Refer to Appendix A for flood extent and flood depth during different scenarios.

The area at risk of flooding falls outside of the proposed development area. In addition, the highest flood level is predicted as 38.25m in the High End future scenario 1 in 1000 year event. This level is 1.25m below the lowest FFL on site, including the lowest proposed basement level, both 39.5m OD, therefore the risk from fluvial flooding is low.

As part of the proposed Fosterstown Masterplan a bridge is proposed across the Gaybrook Stream to the west of the development. The future proposed bridge, which does not form part of the subject application, will have no impact on the capacity of the stream and therefore will not increase the flood risk on site.

3.4 Pluvial

Pluvial flooding is from heavy rainfall and is often referred to as flooding from surface water. Surface water flooding can occur as a result of overland flow or ponding during periods of extreme prolonged rainfall. Flooding may occur through any of the pathways outlined in Table 3-2 and the risk associated with each pathway is outlined below.

Table 3-2: Pathways/Receptors

	Pathway	Receptor
1	Surcharging of the proposed sitewide drainage systems during heavy rainfall events leading to internal flooding	Proposed development – Basement and buildings
2	Surcharging from the existing surrounding drainage system leading to flooding within the subject site by surcharging surface water pipes	Proposed development – Basement and buildings
3	Surface water discharging from the subject site to the existing drainage network leading to downstream flooding	Downstream properties and roads
4	Overland flooding from surrounding areas flowing onto the subject site	Proposed development – Basement and buildings
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

3.4.1 On-site drainage system surcharging

The proposed on-site surface water drainage sewers have been designed to accommodate flows from a 5-year return event which indicates that the site-wide drainage system may surcharge during rainfall events with a return period in excess of five years. Therefore, the likelihood of surcharging of the on-site drainage system is considered high over the lifetime of the development. However, the risk of flooding is mitigated by providing SUDS for the development which can store water for the 1 in 100-year storm event plus a 20% allowance for climate change. In addition, the designed levels fall away from the buildings so as to route any surcharged surface water away from buildings. Therefore, the residual risk is low.

3.4.2 Flooding from the existing surrounding drainage system surcharging

There is no existing drainage system on site.

The proposed development will discharge attenuated surface water to the Gaybrook Stream at existing greenfield rates. Therefore, there will be no impact on the surrounding drainage system from the development.

3.4.3 Surface water discharge from the subject site causing downstream flooding

The proposed development site is 100% greenfield. The development, as designed, will increase the impermeable area on site. As a result, the volume of run-off from the site will increase. However, in order to mitigate against this, permeable paving, green roofs, detention basins, an attenuation tank, and a granular attenuation layer beneath the sports pitch will be used to reduce the volume of run-off from site during low storm events. Surface water discharge from the development will be limited by hydrobreaks with a peak discharge equal to or less than greenfield rates before discharging to the Gaybrook Stream. This will reduce the effects of the development on developments downstream of the site. The likelihood of the proposed development resulting in pluvial flooding downstream of the site is therefore considered low.

3.4.4 Overland flooding from surrounding areas

A map showing all flood events within proximity of the subject site is provided below in Figure 3-3. There are 12 recorded flood events in the vicinity of the subject site. However, none of these events are located within development area. It is therefore considered that there is a low likelihood of flooding from surrounding areas.

The area indicated as having multiple/recurring flood points to the north of the proposed development is at a level of 32 m and therefore there is no flow path from any flooding in this area to the proposed site.

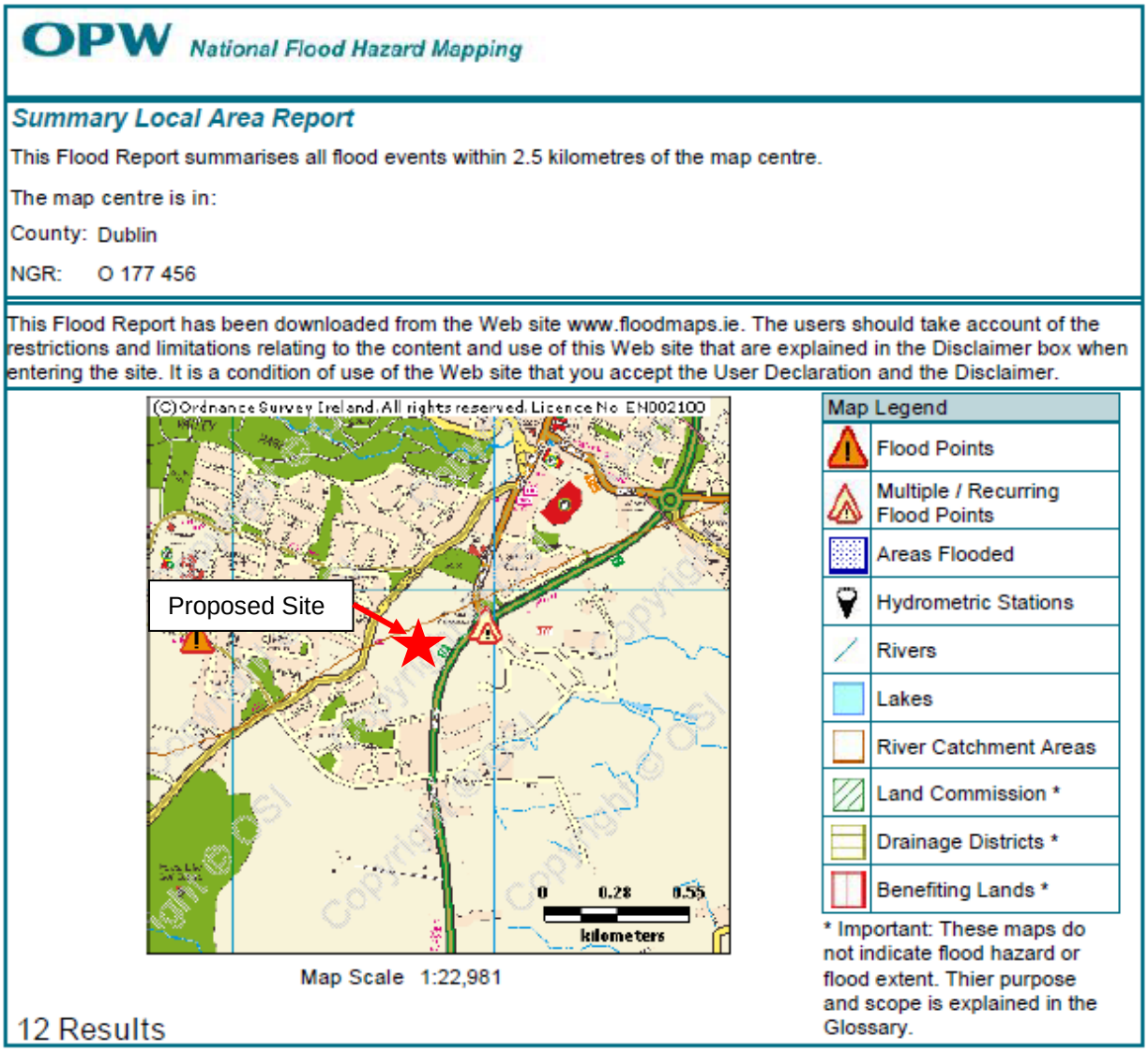


Figure 3-3: OPW National Flood Hazard Mapping

3.4.5 Overland flooding from the subject site

Appropriate drainage will be provided to collect rainwater and discharge to the sitewide SUDS system before finally discharging to the Gaybrook Stream. The levels on site have been designed to ensure any overland flooding which occurs as a result of poor maintenance will be directed along the roads and will not enter the properties. Therefore, the risk to the development from overland flooding is considered low.

Pluvial flooding indicated on the Fosterstown Masterplan SFRA will be mitigated by providing positive drainage throughout the site.

3.5 Groundwater

The sources consulted including the Preliminary Flood Risk Assessment mapping show no indication that the lands within the Fosterstown Masterplan area are subject to groundwater flooding.

In 2005, a site investigation was carried out on site and stated that ground water was found in borehole BH6 at a depth of 6.4m. In trial pits TP1, TP2, TP5 and TP6, there was a record of water seepage between 1.8m and 2.8m below ground level, however, as the lower layers are considered highly impermeable it is considered that this water is from surface water run off percolating through the upper layers as opposed to groundwater on site. Therefore, there is a low risk of groundwater flooding on site. Although the risk of flooding from ground water is considered low, in line with best practice the basement area on site will be adequately waterproofed to prevent any ingress of water through the basement structure. This will be detailed by the design team during the detailed design stage. Therefore, there is low residual risk of flooding from ground water. Refer to drawing 17-062-P216 Overland Flood Route.

3.6 Human / Mechanical Errors

The subject land will be drained by a sitewide storm water drainage system which discharges to the Gaybrook Stream. This surface water network is a source of possible flooding from the system if it were to block. If the proposed private drainage system blocks this could lead to possible flooding within the apartment basement level.

In order to mitigate against the risk of flooding from blockages the surface water network must be regularly maintained and where required cleaned out. The apartment building management team will be expected to prepare and follow a maintenance schedule which ensures all drainage is checked and cleared at least annually and after a heavy storm event.

In addition, all of the on-site SUDS features must be maintained to prevent excessive overgrowth resulting in a loss of storage volume within the SUDS components. As outlined in the Engineering Assessment Report accompanying this application under a separate cover, the SUDS proposals are in line with the Fosterstown Masterplan requirements.

Upon adoption of the proposed flood risk management strategies, outlined above, there is a low residual risk of overland flooding from human / mechanical error.

4. Sequential Test

A sequential approach to planning is a key tool in ensuring that development, particularly new development, is first and foremost directed towards land that is at low risk of flooding. The sequential approach is set out in *"The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009"* and shown in Figure 4-1 below.

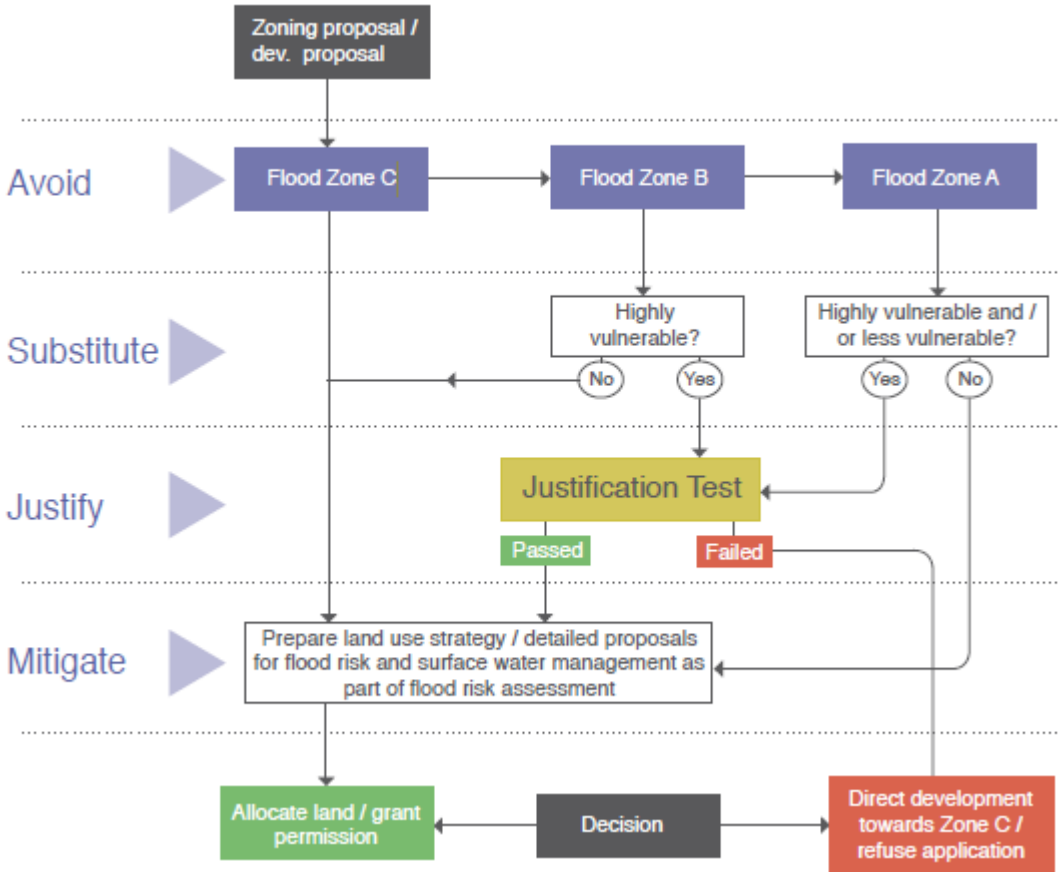


Figure 4-1: Sequential Approach (extract from Dublin City Council Development Plan 2016-2022 SFRA)

Figure 4-3 below lists the vulnerability classes assigned to each land use and type of development and Figure 4-2 outlines the matrix of vulnerability versus flood zone. Residential development is classified as "Highly vulnerable" development and Amenity open spaces are classes as "Water compatible" developments. As a small section of the development site where the proposed linear park is located is in flood Zone A, therefore, for completeness, a justification test has been provided in the next section.

Figure 4-3 Matrix of vulnerability versus flood zone (The Planning and Flood Risk Management Guidelines for Planning Authorities, 2009, OPW)

	FLOOD ZONE A	FLOOD ZONE B	FLOOD ZONE C
Highly vulnerable development	JUSTIFICATION TEST	JUSTIFICATION TEST	APPROPRIATE
Less vulnerable development	JUSTIFICATION TEST	APPROPRIATE	APPROPRIATE
Water-compatible development	APPROPRIATE	APPROPRIATE	APPROPRIATE

Figure 4-2 Classification of Vulnerability of different types of development. (The Planning and Flood Risk Management Guidelines for Planning Authrorities, 2009, OPW)

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

*Uses not listed here should be considered on their own merits

4.1 Justification Test

The proposed development consists mainly of Residential buildings, however as outlined in section 3.3 above, the residential buildings are located in flood Zone C and are not at risk of flooding and therefore a Justification test is not required for these buildings.

The Justification test only applies to the section of public open space and footpath to the northeast of the development, located in Flood Zone A. Amenity open space is classified as Water Compatible development, see Figure 4.3 above and as outlined in Figure 4.2 above Water Compatible development is appropriate in Flood Zone A therefore the Justification test is met,

Furthermore, as outlined in the Strategic Flood Risk Assessment carried out by Roughan & O'Donovan for The Swords Masterplans Part C: Fosterstown, *"The majority of the Residential Area zoned lands are not affected by current and future estimated fluvial or tidal flood risk. However, the culvert under the Dublin Road appears to have insufficient capacity for extreme events. This causes flooding in a very small area on the eastern boundary of the Fosterstown Masterplan lands and on the Dublin Road. It is recommended that the lands subject to the 0.1% AEP (HEFS) fluvial flood extent shown in Appendix G Drawing 18.164-FT-107 be designated for appropriate uses such as amenity space.*

5. Conclusions and Recommendations

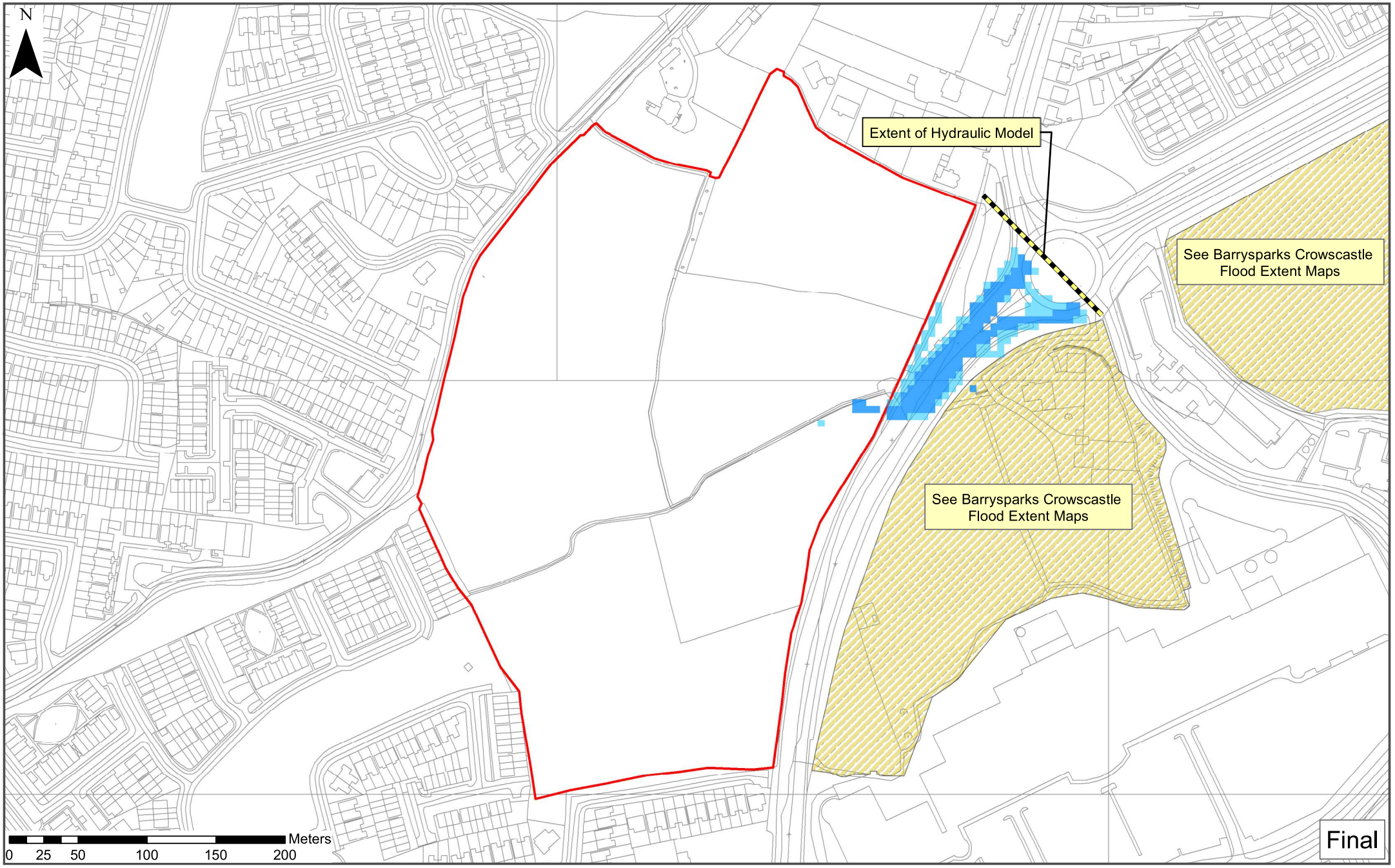
The subject site has been analysed for risks from tidal and fluvial flooding from the Gaybrook Stream, pluvial flooding, groundwater and drainage system failures due to human error or mechanical system failure. Table 5-1 below presents the various residual flood risks involved. As the flood risk from all sources can be mitigated, reducing the flood risk to low or very low, the proposed development is considered acceptable in terms of flood risk.

Table 5-1 Summary of the Flood Risks from each flooding type

Source	Pathway	Receptor	Likeli-hood	Consequence	Risk	Mitigation Measure	Residual Risk
Tidal	Gaybrook Stream/ Ward River	Proposed Development and Basement	Very Low	Moderate. Water ingress into the buildings and the basement	Very Low	None required	**Very Low**
Fluvial	Culvert in Old Dublin Road	Proposed Development and Basement	Very Low	Moderate. Water ingress into the buildings and basement	Very Low	None required	**Very Low**
Pluvial	Private and Public Drainage Network	Proposed Development and Basement	High	High. Flooding of the buildings and basement	High risk of damage to the buildings and basement	Appropriate drainage design, over land flood routing and setting of appropriate floor levels	**Low**
Ground Water	Groundwater present in the ground seeping through basement walls and floor	Basement Areas	Low	Moderate. Ground water ingress into basement	Low	Adequately waterproof the basement structure	**Low**
Human / Mechanical Error	Drainage network	Proposed Development and Basement	High	Moderate. Water ingress into the buildings and basement	Moderate risk of damage to the buildings	Maintenance strategy	**Low**

Appendices

A. Fluvial Flood Extents



Legend

- Fosterstown Masterplan Lands
- Barrysparks Crowscastle Masterplan Lands
- Fosterstown - 1 in 100 Year Fluvial Event - High End Future Scenario
- Fosterstown - 1 in 1000 Year Fluvial Event - High End Future Scenario

No.	Revision	Date	By	Chk'd	App'd
F01	Final Flood Extents	09/05/2019	BP	WV	JPR
D02	Draft Flood Extents	25/02/2019	BP	WV	JPR
D01	Draft Flood Extents	25/01/2019	BP	WV	JPR

Stage	Date	App'd
PRELIMINARY		
APPROVAL		
TENDER		
CONSTRUCTION		

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Designed:	Checked:	Approved:	Status:
BP	WV	JPR	FINAL

Project Title: Fosterstown Surface Water Management Plan

Drawing Title: Fluvial Flood Extents (High End Future Scenario)

Drawn:	Job No:	Drawing No:	Rev:
BP	18.164	18.164-FT-107	F01

Scale: 1:2,500 (@ A3) Date: 25/02/2019

09 May 2019 18:23:40 Drawing Location: J:\2018\18164\18164-02_WIP\08 MODELS\05 GIS\01 MXD\Flood Extents\Final\Fluvial\18.164-FT-107 Fluvial Flood Extents HEFS F01.mxd

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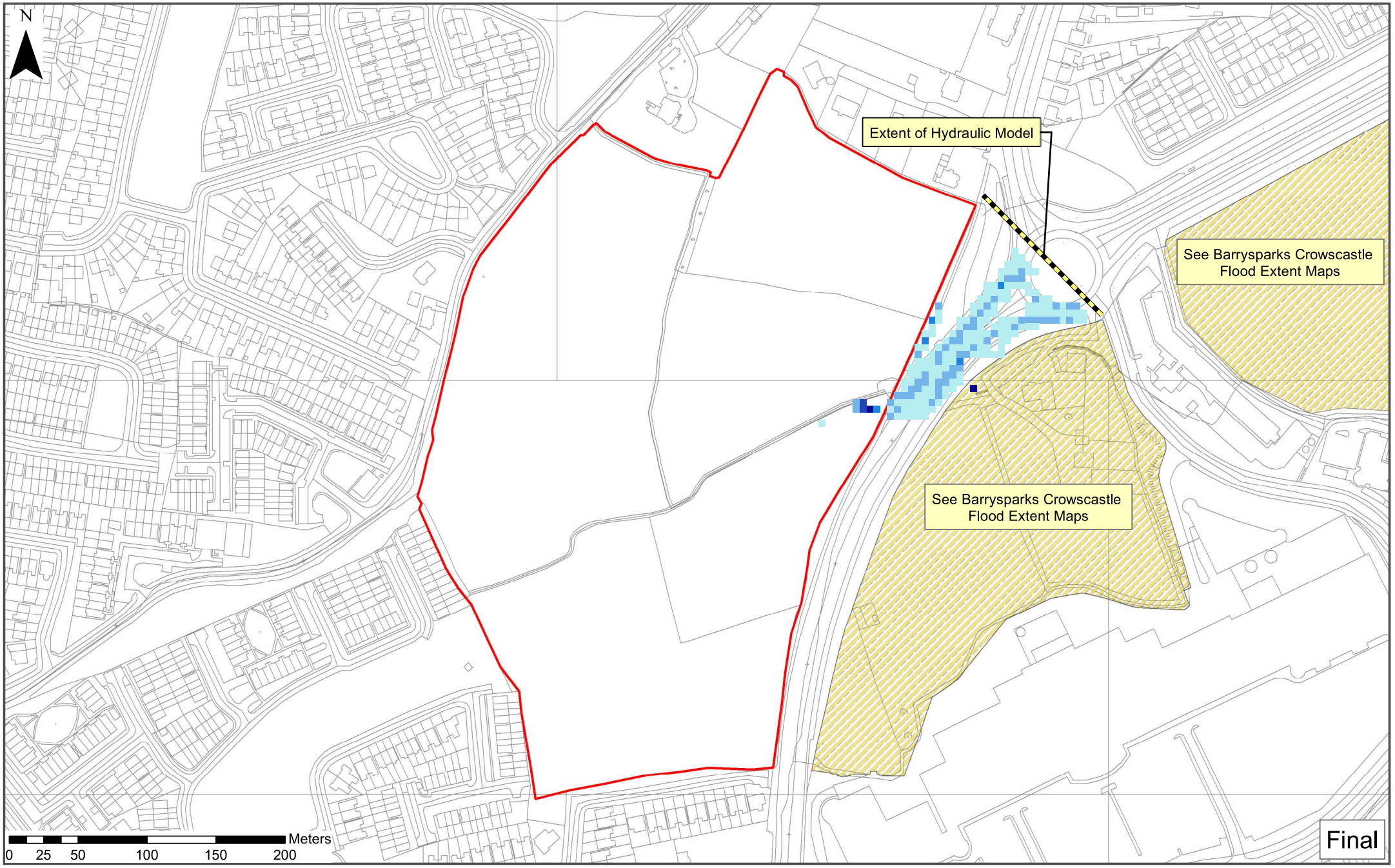

Legend

Depth (m)

- 0 - 0.1m
- 0.1 - 0.2m
- 0.2 - 0.3m
- 0.3 - 0.4m
- 0.4 - 0.5m

- Fosterstown Masterplan Lands
- Barrysparks Crowscastle Masterplan Lands

No.	Revision	Date	By	Chk'd	App'd
F01	Final Flood Depths	09/05/2019	BP	WV	JPR
D02	Draft Flood Depths	25/02/2019	BP	WV	JPR
D01	Draft Flood Depths	30/01/2019	BP	WV	JPR

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Designed: BP | Checked: WV | Approved: JPR | Status: FINAL

Project Title: Fosterstown Surface Water Management Plan

Drawing Title: Fluvial 1 in 1000 Year Flood Depths (High End Future Scenario)

Drawn: BP | Job No: 18.164 | Drawing No: 18.164-FT-214 | Rev: F01

Scale: 1:2,500 (@ A3) | Date: 25/02/2019

09 May 2019 17:09:53 Drawing Location: J:\2018\18164\18164-02_WIP\08 MODELS\05 GIS\01 MXD\Flood Depths\Final\Fluvial\18.164-FT-214 Fluvial Flood Depths HEFS Q1000 F01.mxd

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