Broombridge-Hamilton Masterplan Strategic Flood Risk Assessment

Technical Report

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www.jbaconsulting.ie

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This report describes work commissioned by Dublin City Council.

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Purpose

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Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
CFRAM	Catchment Flood Risk Assessment and Management
DCC	Dublin City Council
DCDP	Dublin County Development Plan
DTM	Digital Terrain Model
EPA	Environmental Protection Agency
FEH	Flood Estimation Handbook
FFL	Finished Floor Level
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FRR	Flood Risk Review
FSU	Flood Studies Update
GIS	Geographical Information System
HEFS	High End Future Scenario
HPW	High Priority Watercourse
JFLOW	2-D hydraulic modelling package developed by JBA
JT	Justification Test
LA	Local Authority
MPW	Medium Priority Watercourse
MRFS	Medium Range Future Scenario
OPW	Office of Public Works
OSi	Ordnance Survey Ireland
PFRA	Preliminary Flood Risk Assessment
RSES	Regional Spatial and Economic Strategy
RMS	Rainwater Management Strategy
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1 Introduction

1.1 Terms of Reference

JBA Consulting was appointed by Dublin City Council to carry out the Strategic Flood Risk Assessment to inform the Masterplan for the lands at Broombridge-Hamilton. Hereafter, this will be referred to as an SFRA.

1.2 Background

The Core Strategy identifies the Dublin Industrial Estate as a 'Future Development Area' in the City – see section 2.4.5 of the Written Statement. It is the intent of the Council that, following feasibility studies, that these wider industrial lands will be brought forward as regeneration lands during the lifetime of the Development Plan under a Masterplan.

The SFRA clarifies that "Any such change would require an amendment to the zoning of the lands and would be subject to a SFRA as part of that process.". This Masterplan has been prepared to enable the compact and sustainable mixed-use regeneration and redevelopment of the area, supported by high-quality public transport in accordance with the Core Strategy of the Development Plan. The working title given to this land use plan is the "Broombridge-Hamilton Masterplan" (the Masterplan), this document provides the SFRA for the Masterplan area.

The Masterplan area and environs is largely zoned for employment and enterprise under a Z6 zoning objective in the Dublin City Development Plan 2022-2028. This Z6 zoning objective seeks to provide for the creation and protection of enterprise and facilitate opportunities for employment creation. Given that the Z6 zoning objective does not provide for residential development, rezoning of the Masterplan lands will be required to implement the proposed Masterplan. Lands Zoned as Z1 are under existing residential use and will not be redeveloped other than to incorporate SuDS features.

These lands are hereafter defined as the Masterplan lands. The extent of the lands subject to the masterplan are identified in Figure 1-1.

Figure 1-1: Masterplan area

This report details the SFRA for this area and has been prepared in accordance with the requirements of the DoEHLG and OPW Planning Guidelines, The Planning System and Flood Risk Management[1]; these guidelines were issued under the Planning and Development Act and recognise the significance of proper planning to manage flood risk.

1.3 SFRA Overview

The Masterplan SFRA will be the key document for setting out a vision for the development of the area. It should be noted that the SFRA sits under the Dublin City Development Plan 2022-2028 and its SFRA. The strategy and Policy outlined in the City Development Plan written statement and SFRA is consistently applied in this document; more specifically in relation to the Eastern and Midland Assembly's (EMRA) "Regional Spatial and Economic Strategy, 2019 – 2031 (RSES). The RSES includes the Dublin Metropolitan Area Strategic Plan (MASP).

The Masterplan area is situated in the Dublin MASP's City Centre within the M50 development corridor which is identified for strategic brownfield regeneration see section 2.4.1 of the Written Statement. The proposed Masterplan is identified as a priority Local Area Plan under the new City Development Plan in accordance with Objective CSO1: Feasibility Study and Local Statutory Plan for Z6 Zoned Lands at Glasnevin. It is noted that the lands also include Z1 Sustainable Residential Neighbourhoods in the north east corner which are retaining the existing built form, but will incorporate SuDS features along the eastern boundary through existing open space.

Development Plan Policy SI14 requires that regard is had to the Flood Risk Management Guidelines (2009) in the preparation of statutory plans. The proposed Masterplan lands are contained within Area 23 (Tolka: Finglas Road – City Boundary) of the Development Plan's SFRA and are subject to Flood Zones A, B and C. This area assessment states that an SFRA is required to be prepared in support of any future rezoning/ redevelopment of the Dublin Industrial Lands together with the integrated/ area based provision of SuDS [2].

In respect to the adjoining Tolka Valley Park, the area assessment notes that Tolka Valley Park provides a natural flood plain to the River Tolka and Finglas Stream and the water compatible use must be maintained.

To avoid unnecessary duplication of the policy background and descriptions of the context of the Planning System and Flood Risk management Guidelines it is recommended that this document is read in conjunction with the Dublin City Development Plan 2022-2028 SFRA. Sections 1 - 3 of the SFRA document cover the background to the Policy and Planning Guidelines.

1.3.1 Purpose

The purpose of this work is to provide a broad assessment of flood risk to inform strategic land-use planning decisions and the master planning of the Masterplan lands. This is in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009.

Within the SFRA the Justification Test for SFRA clarifies that.

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[1] DoHELG and OPW (2009) The Planning System and Flood Risk Management: Guidelines for Planning Authorities

[2] Dublin City council (2023) *Strategic Flood Risk assessment and Nature-Based Surface Water Management Strategy Quotation Brief To Procure Consultants.* Dublin: Dublin City council. Available from: Local Area Plan for Baile Bogáin (Ballyboggan) | Dublin City Council [Accessed 10 July 2024]

1 SFRA identifies brownfield sites with the potential to deliver a significant quantum of residential and mixed-use development and it sets out a framework plan and guiding principles to guide the development of the area.

2 Any development could reasonably be accommodated within the extents of Flood Zone C and should not need to extend into Flood Zone A or B.

Furthermore, the SFRA is seen as an opportunity to implement best practise in terms of both flood risk management and stormwater management. As such under Section 13.5 of the DCDP Written Statement it is further clarified that in terms of the consideration of Green Infrastructure the following should be considered:

3 Retention of existing open watercourses with an appropriate riparian zone.

4 The exploration of opportunities to de-culvert existing watercourses and their incorporation into the Masterplan where possible.

5 Extensive tree planting including along street avenues.

6 Biodiversity planting.

7 Play.

The key item above is highlighted in bold and confirms the general application of the sequential approach. The additional objectives of de-culverting and creating an appropriate riparian zone have been investigated but there is limited opportunity to do so given the 3-5m depth of the 750mm pipe under the canal and it's pathway towards the Tolka, this is clarified in more detail under the Rainwater Management Strategy (RMS).

Building on the requirements of the DCDP the SFRA and RMS will seek to initially identify the watercourses through the Masterplan lands, look at the potential flood risk from all sources of flooding, including the Grad Canal and undertake a residual risk analysis for this feature.

1.4 Disclaimer

It is important to note that, although prepared in compliance with the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009, the SFRA is a work in progress and is based on emerging and best available data at the time of preparing the assessment.

Accordingly, all information in relation to flood risk is provided for general policy guidance only, and may be substantially altered in light of future data and analysis, or future flood events. As a result, all landowners and developers are advised that Dublin City Council and their agents can accept no responsibility for losses or damages arising due to assessments of the vulnerability to flooding of lands, uses and developments. Owners, users and developers are advised to take all reasonable measures to assess the vulnerability to flooding of lands and buildings (including basements) in which they have an interest prior to making planning or development decisions.

This SFRA should be reviewed when a new LAP or Development Plan is being made, once the OPW food map review of the River Tolka is complete, following completion of significant flood relief schemes and after significant flood events to ensure that its content and emphasis remains relevant, as laid out in Section 5.

1.5 Technical Principles

1.5.1 Return Periods

The probability of a flood event is classified by its annual exceedance probability (AEP) or return period (in years). A 1% AEP flood will occur on average once every 100 years and has a 1 in 100 chance (or 1%) of occurring in any given year.

AEP can be a helpful concept as return period is often misunderstood to be the period between large flood events rather than an average recurrence interval. Annual exceedance probability is the inverse of return period as shown in Table 1-1.

Table 1-1 Return Periods & Annual Exceedance Probabilities

Return Period (Years)	Annual Exceedance Probability (%)
2	50
10	10
30	3.3
50	2
100	1
200	0.5

1.5.2 Climate Change

The Planning Guidelines (originally published in 2009) recommend that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects.

OPW climate change guidance is documented in the "Flood Risk Management Climate Change Sectoral Adaptation Plan", and recommends two climate change scenarios for consideration. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). The MRFS is intended to represent a "likely" future scenario based on the wide range of future predictions available. The HEFS represents a more "extreme" future scenario at the upper boundaries of future projections. Based on these two scenarios the OPW recommended allowances for climate change are given in Table 1-2.

Table 1-2 Future Condition Adjustments

	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000mm
Land Movement	-0.5mm / year*	-0.5mm / year*
Urbanisation	No General Allowance - Review on Case by Case Basis	No General Allowance - Review on Case by Case Basis
Forestation	-1/6 Tp**	-1/3 Tp** +10% SPR***

Notes:
* Applicable to the southern part of the country only (Dublin - Galway and south of this)
** Reduce the time to peak (Tp) by a third; this allows for potential accelerated runoff that may arise as a result of drainage of afforested land
*** Add 10% to the Standard Percentage Runoff (SPR) rate; this allows for increased runoff rates that may arise following felling of forestry

2 The Masterplan Study Area

2.1 Introduction

The proposed Masterplan area is located to the west of Glasnevin Cemetery, north of Cabra, south of Finglas and to the east of Pelletstown with an area of approximately 75 hectares, to include the Masterplan area, adjoining industrial estates and lands to Bannow Road.

2.2 Watercourses

The Royal Canal crosses the Masterplan boundary from west to east, parallel to the railway line. It features a series of bridges and locks along its route.

Additionally, the River Tolka follows the northern edge of the Masterplan boundary, flowing through Tolka Valley Park in a general alignment similar to the Royal Canal. The Bachelors Stream (Finglas Stream) joins the River Tolka upstream and approximately 187m outside of the Masterplan boundary, to the north.

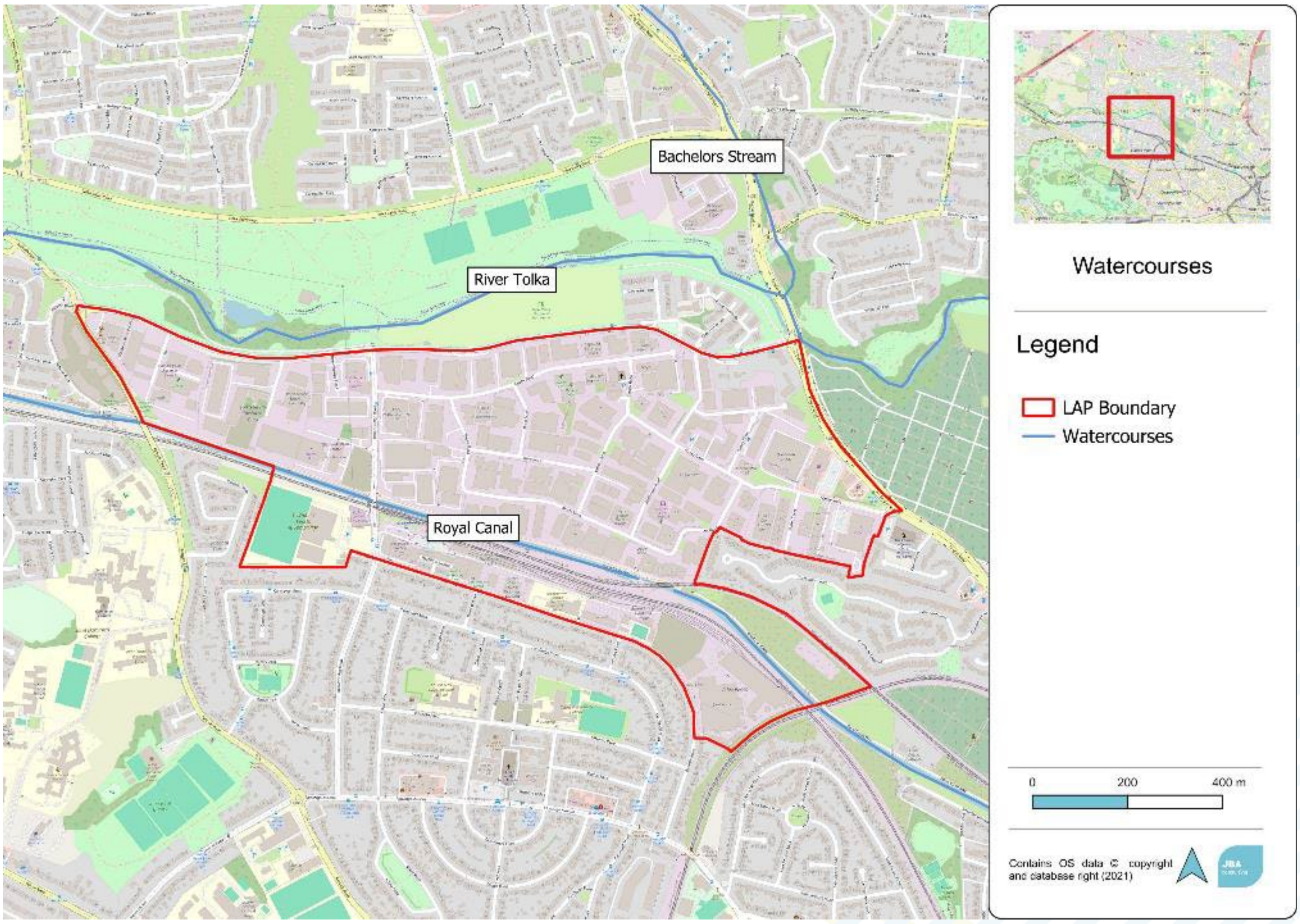

Figure 2-1: The Masterplan area and Rivers

2.3 Royal Canal

The Royal Canal extends 146 km from Dublin to the River Shannon. It rises through a series of locks, reaching its peak level near Mullingar before descending to join the Shannon at Richmond Harbour. Work on constructing the canal was completed in 1817. The canal was closed in 1961 and, following extensive restoration work, was reopened in 2010 for navigation.

Waterways Ireland is the cross-border navigation authority responsible for the management, maintenance, and development of seven inland navigable waterways, including the Royal Canal. Water levels in the canal are controlled, and the infrastructure is subject to regular monitoring and maintenance by Waterways Ireland.

Waterways Ireland were contacted regarding this stretch of the waterway and commented that;

- The Royal Canal is generally independent from land drainage however does have occasional historical connections, one being east of Lock 8.
- Water levels are controlled by the downstream lock gates, sometimes assisted by allowing small flows to pass through the sluices within the lock gates, and;
- This process of water management is checked on a daily basis by Waterways Ireland.
- Where a canal is 'embanked' there is always a potential leakage risk (which is most likely the case for the flood event noted at Broombridge station, see Section 3.2).
- An embankment failure would cause a greater impact but the probability of occurrence is very low. In Ireland this has only ever occurred in the bog embankments in the midlands (2 no. breach failures in 1980s / 90s).

While not a matter for determination of Flood Zones, the potential risk of flooding due to canal / impoundment breach has been considered further for the purposes of Masterplanning. Further guidance is provided on general risk zones, conveyance routes and development levels. Further information is provided in Section 4.2.

2.4 Existing Stormwater Network

Dublin City Council provided a number of datasets related to the local stormwater network in GIS format to JBA Consulting. Uisce Eireann also provided network details for all of their assets within the study area.

A review of the stormwater network indicates that a robust dataset is available for the Masterplan area. Whilst a lot of the minor stormwater infrastructure elements will be replaced as part of the proposed RMS, which is provided under separate cover. An overview of the existing stormwater network is provided in Figure 2-2 below.

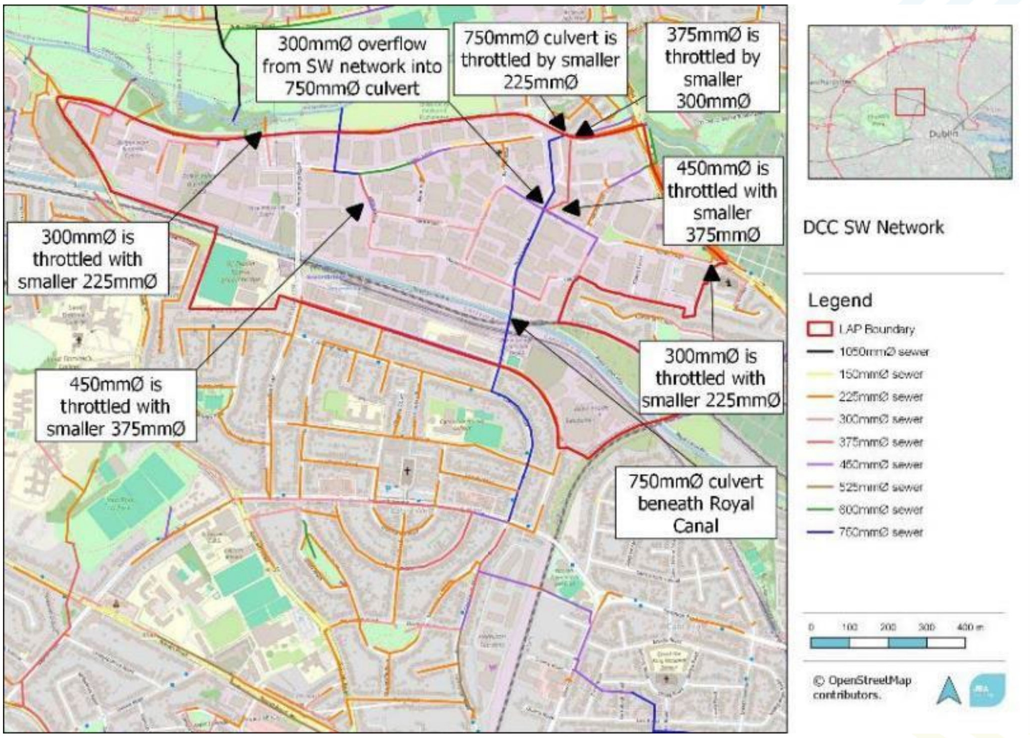

Figure 2-2: DCC Surface Water Network (Source: DCC)

3 Data Collection and Review

This section reviews the data collection and the flood history for the settlements so that any additional information on flooding can be included within this SFRA. It will confirm the extent of extreme flooding (through the Flood Zone mapping) and key sources of flood risk.

Table 3-1: Available Flood Data for Flood Zone Development

Description	Coverage	Robustness	Comment on usefulness
OPW CFRAM	River Tolka and tributaries	N/A	Mapping has been removed from public display by OPW from floodinfo.ie website. Legacy version exists on DCC Development Plan.
OPW NIFM Flood Mapping	Covers the River Finglas and tributaries.	Moderate	Shows flooding in the local area in the north east corner of the Masterplan boundary.
JBA Pluvial Mapping	Entire Masterplan area	Moderate	Indicative 2D rain on grid pluvial model incorporating allowance for land cover and drainage. Represents topographically driven overland flow pathways.
DCC Pluvial Flood Mapping	City wide model EU Interreg IVB FloodResilienCity	Low	Shows many accumulations of stormwater in many isolated pockets. Does not represent any existing stormwater system and is of limited use.

Table 3-2 Other Available Data

Description	Coverage	Robustness	Comment on usefulness
GSi Groundwater and Surface Water flood information	Full Study Area	Moderate	Provides both historic and predictive flood extents for groundwater and historic surface water flooding.
UE stormwater network	Full Study Area	Low	Watermain and overflows in the Masterplan area.
GDSDS Network Model	Full Study Area	Moderate	Used to show the existence of the stormwater network/culverts and pathways.
GDSDS Watercourse Mapping	Full Study Area	Moderate	The most accurate representation of the watercourses around the site.
Site Walkover	Specific areas of interest	Moderate	Helpful for assessing flood risk in areas where mapping is unavailable. Used to verify existing mapping and discovery of unmapped piping.
Historic Flood Records including photos, aerial photos and reports.	Coverage of most of Masterplan area from 2009 flood event and spot coverage for other events	Various	Shows several historical events in proximity to the site.

LiDAR height model	Masterplan area	High	Aerial survey is used to appraise the topography and identify low spots, floodplain and areas potentially susceptible to flooding.

All sources of available flood mapping were reviewed and at an early stage in the project it was identified that the CFRAM data is no longer available for the River Tolka and is being updated but will not be ready for the publication o the Masterplan. NIFM data will be used instead, as the next best available dataset.

Specific guidance is provided for the parts of the Masterplan area potentially impacted by flooding. During the site visit the flood mapping was appraised on site by an experienced flood risk manager and professional opinion and judgement has been used to develop the recommendations within the Settlement Review of Section 4.

The review of the flood risk data has been developed as a spatial planning tool to guide DCC in making land-use zoning and development management decisions. The data sets have been deemed appropriate for the planning decisions being made at this stage of the master planning process and where flood risk is identified the following approach has been undertaken;

- Application of the Justification Test and/or;
- Further detailed analysis, or;
- Identification of a less vulnerable use, or;
- Further assessment at detailed design stage in the Masterplan process where it has been determined that development should be possible in principle.

3.1 Site Walkover

As part of the SFRA process a site walkover and consultation was undertaken at Broombridge-Hamilton by suitably experienced staff. The site walkover took place on 27/03/2024 and aimed to assess risks presented by potentially unmapped watercourses, to verify NIFM mapping, confirm the extent for the modelling and to assess the inlets outfalls and bridges for blockage.

3.2 Historic Flooding

A number of three recent past flood events occurred within or around the Masterplan boundary shown in Figure 3-1 and Figure 3-2 below.

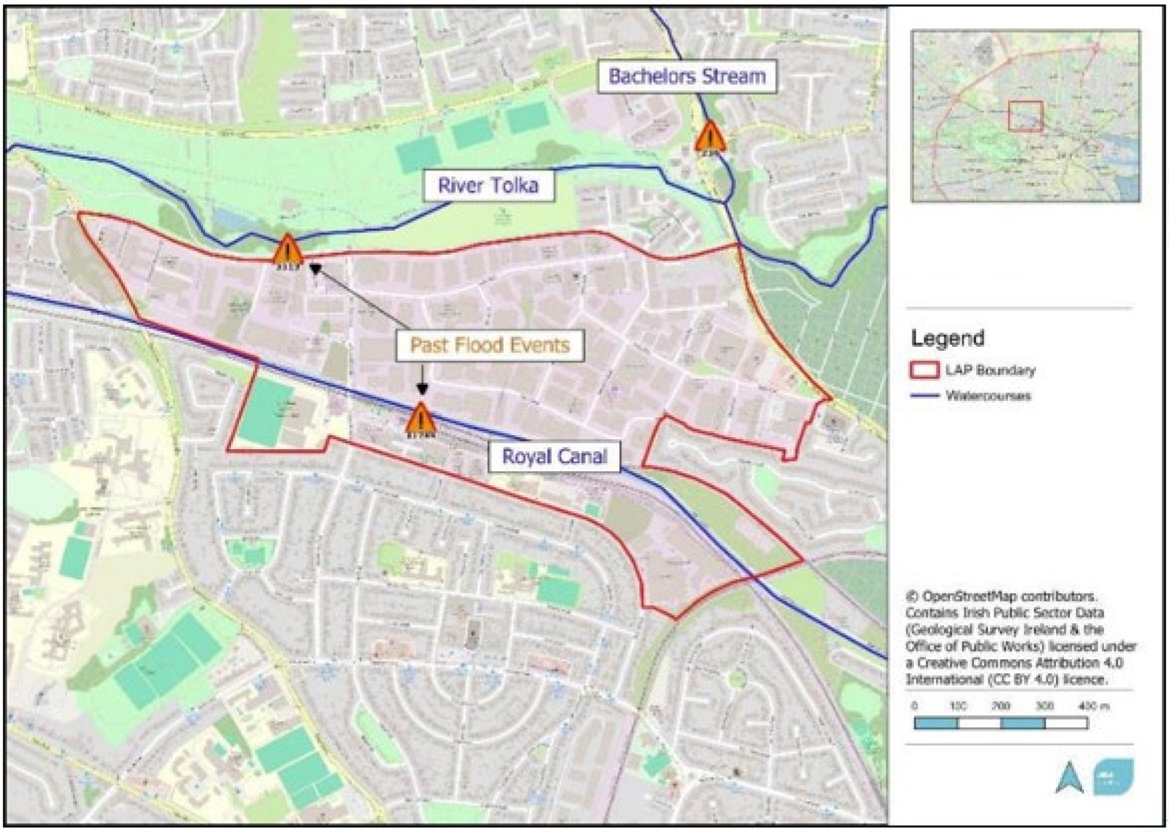

Figure 3-1: Historic Flooding

Table 3-3 provides details of recent flood events that have impacted on the local area.

Table 3-3: Summary of Historic Flood Events (www.floodinfo.ie)

Date	Source of Flooding	Areas impacted
24th October 2011	Surface water / canal overtopping – Royal Canal	The canal overflowed which may have been due to a blockage at Glasnevin. The drainage on the road was blocked or was unable to cope with the volume of water and it flowed in to the station. The drains from the local housing estates are in the direction of the railway, which may have impacted on the flood. Sligo Intercity and Maynooth commuter services were suspended due to flooding at Broombridge Station. Consultation with Waterways Ireland (discussed in Section 2.3) would suggest that the surcharging surface water system may have fed into the canal and then caused some overtopping of the canal at this location.
August 1984	Fluvial – Tolka and Finglas Rivers	Flooding at the junction between Tolka and Finglas Rivers at Finglas Bridge. This impacted the Royal Oak pub and carpark (now demolished), properties on the junction of the Finglas Road and Old Finglas Road, but did not encroach within the Masterplan lands. A number of flood defences were put in place by DCC since the flood occurred. Figure 3-2 contains a map of the historic flood extents.

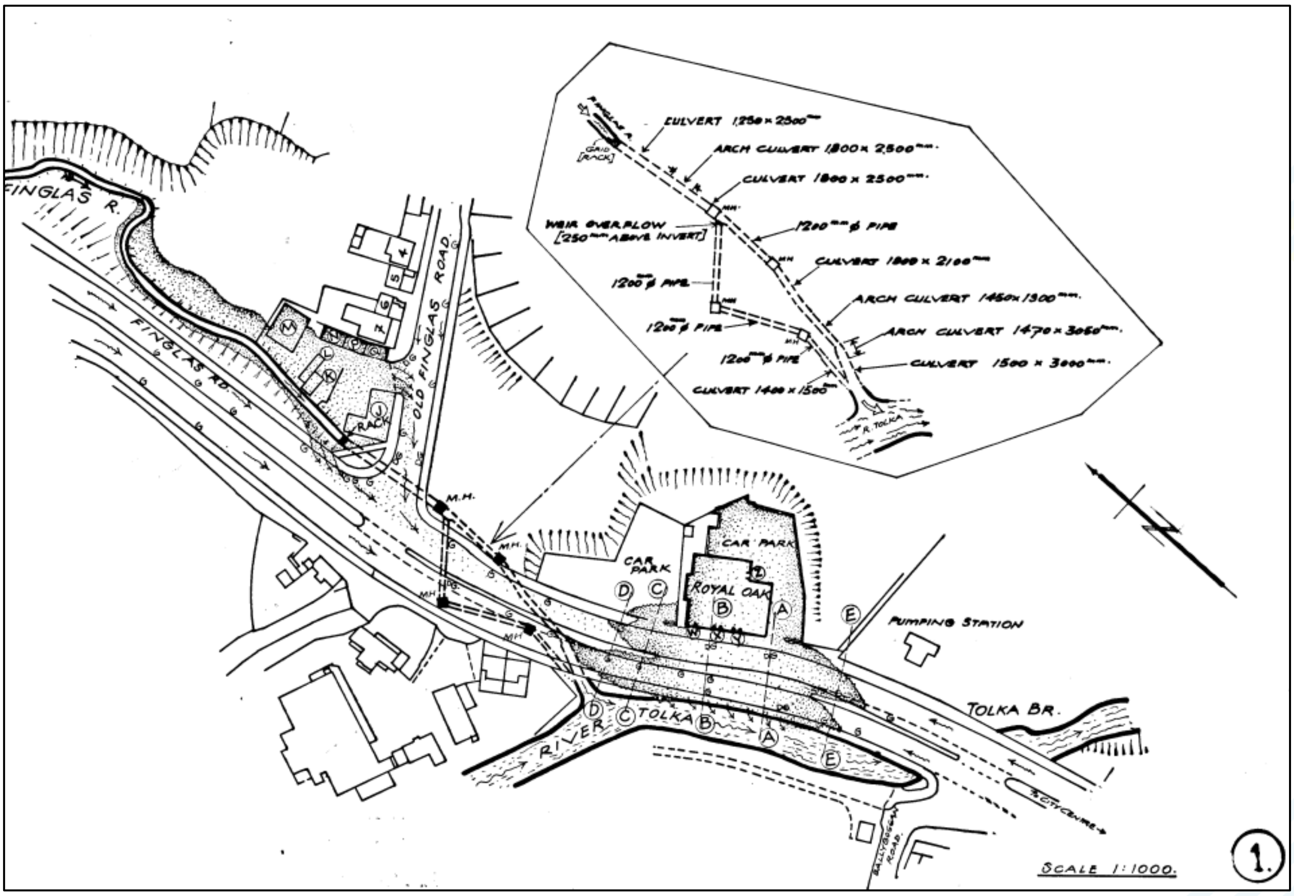

Figure 3-2: August 1984 Historic Flood Map (source: www.floodinfo.ie)

3.3 Dublin Flood Resilient City Pluvial Mapping

The EU Interreg IVB FloodResilienCity Project provides some indicative pluvial mapping for Greater Dublin. For the project, a city-wide model provided a high-level assessment of pluvial flood risk across Dublin and five Pilot Areas were identified for further detailed investigation of potential pluvial flood risk. Figure 3-3 below shows a map with the pluvial flood outlines. The mapping indicates accumulations of stormwater in many isolated pockets throughout the Masterplan boundary. The granularity of the base topographic data is coarse, the detail of the stormwater network is also not explicitly modelled, neither is the provision of any infiltration and the results have a low level of confidence.

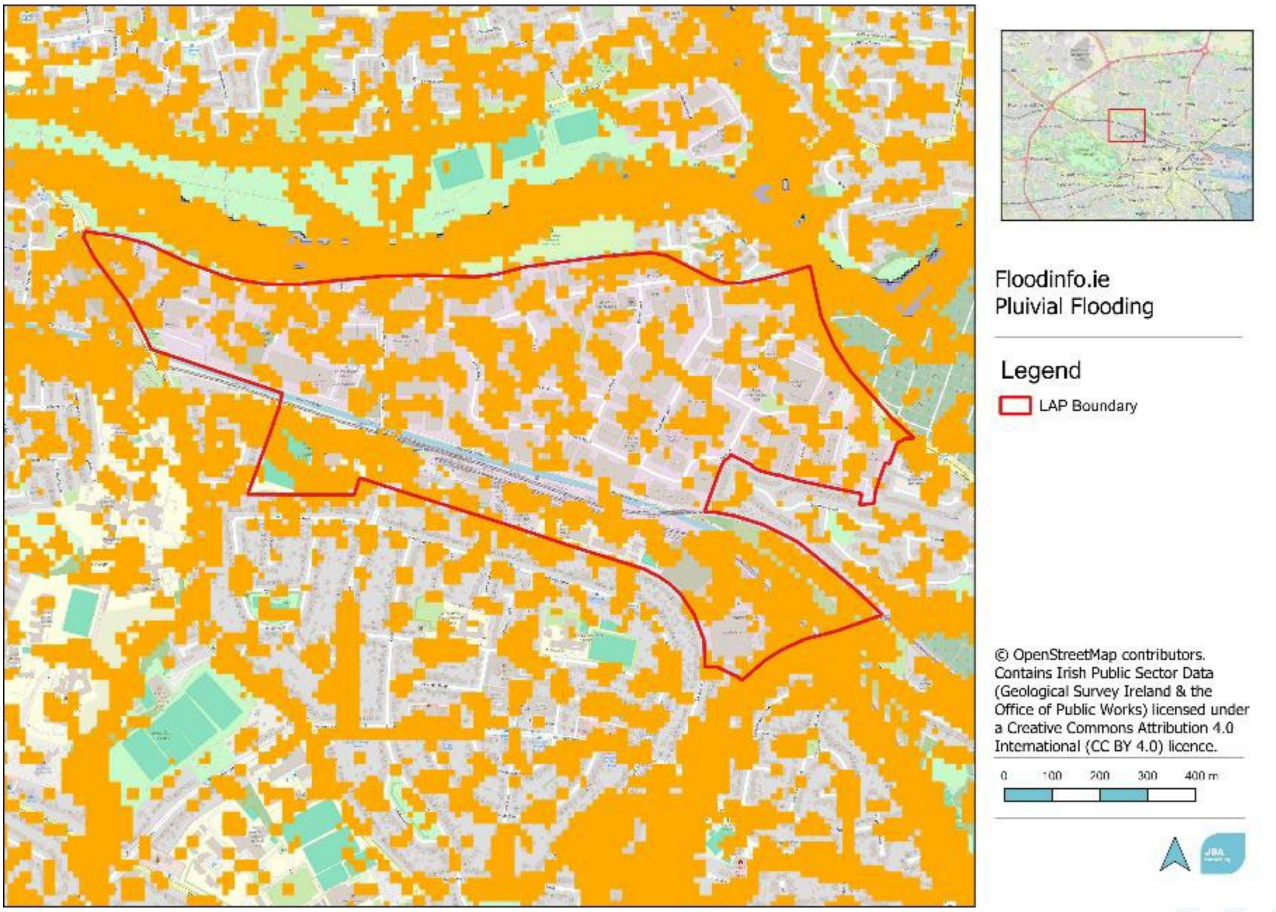

Figure 3-3: FloodResilienCity Flood Map

3.4 JBA Pluvial Mapping

In order to increase the quality of the pluvial information alternative pluvial mapping has been used. The surface water flood map shows the estimated extent of flooding from heavy rainfall at the 200-year (0.5% AEP) event. It utilises a methodology that is more detailed and accurate than the FloodResilienCity mapping.

Under the JBA approach surface water is modelled using rainfall datasets, which account for varied rainfall across the country. A catchment-based approach is adopted and the rainfall estimations are used to generate a hyetograph for two storm durations of one hour and ten hours. A hyetograph illustrates the distribution of rainfall over time and JBA has modelled two storm durations to account for terrain conditions: steep terrain can flood very quickly while flat terrain takes longer to flood and for water to drain away. The resulting depth data from the two models are merged so that the deepest and most extensive depths are used in the flood maps.

Adjustments are made to the hyetograph to allow for infiltration and drainage. To account for local drainage factors, the 5-year rainfall is removed from the calculation. For infiltration, land use and soil types are identified allowing for different rates (mm/hr) to be removed. Each 5m x 5m grid square within the 5km2 tile or catchment is treated independently and categorised as urban, suburban or rural. In urban areas, drainage is removed; in rural areas, an allowance for infiltration is made. In suburban areas, water is removed for both infiltration and drainage, using a weighting technique.

The rainfall is allowed to spread over the DTM in the 2D hydraulic model to produce peak flood depths. For the data to be usable, a depth threshold is required in order to generate flood extents. JBA has removed locations where depths are below 0.1m, as below this depth, flood water generally would not enter a property, though it may start restricting access.

The model results show isolated pockets of potential pluvial flood risk. Given the extensive redevelopment of the Masterplan area then there is significant opportunity to manage the risk more sustainable and at source, so as to avoid significant accumulations.

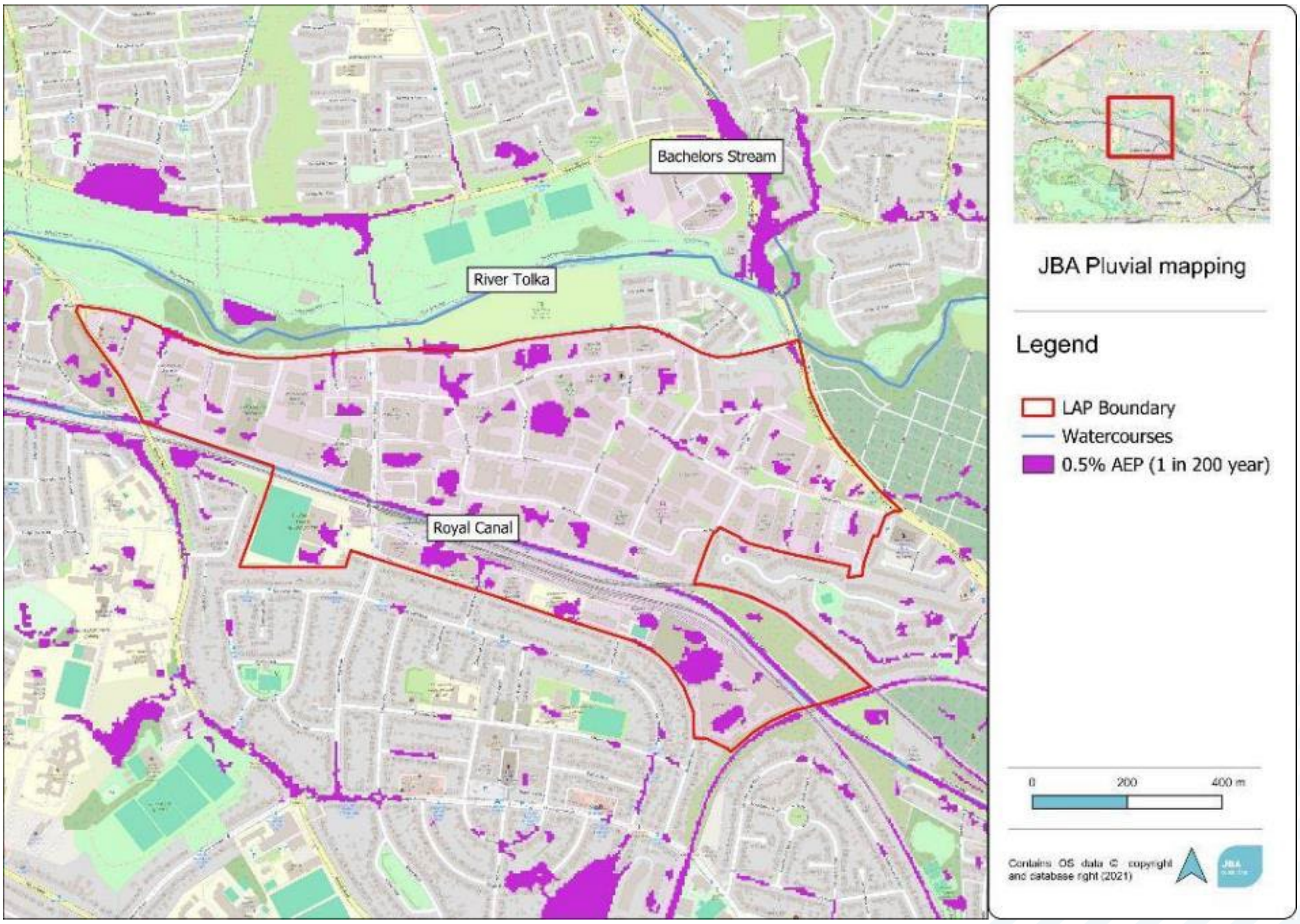

Figure 3-4: JBA Pluvial Mapping 0.5% AEP

3.5 CFRAM

In 2011 the OPW commenced appointment of consultants to carry out a more detailed flood risk assessment on key flood risk areas. This work was undertaken under the CFRAM programme across seven river basin districts in Ireland.

The Tolka was modelled under the Eastern CFRAM, however the flood maps are under review and the results are not available until later in 2025 and the existing CFRAM maps have been removed from public display.

The Dublin City Development Plan 2022-2028 did use the CFRAM mapping for use as the Flood Zones and these are presented below in Figure 3-5. The legacy mapping indicates that the River Tolka Flood Zones do not extend within the Masterplan lands.

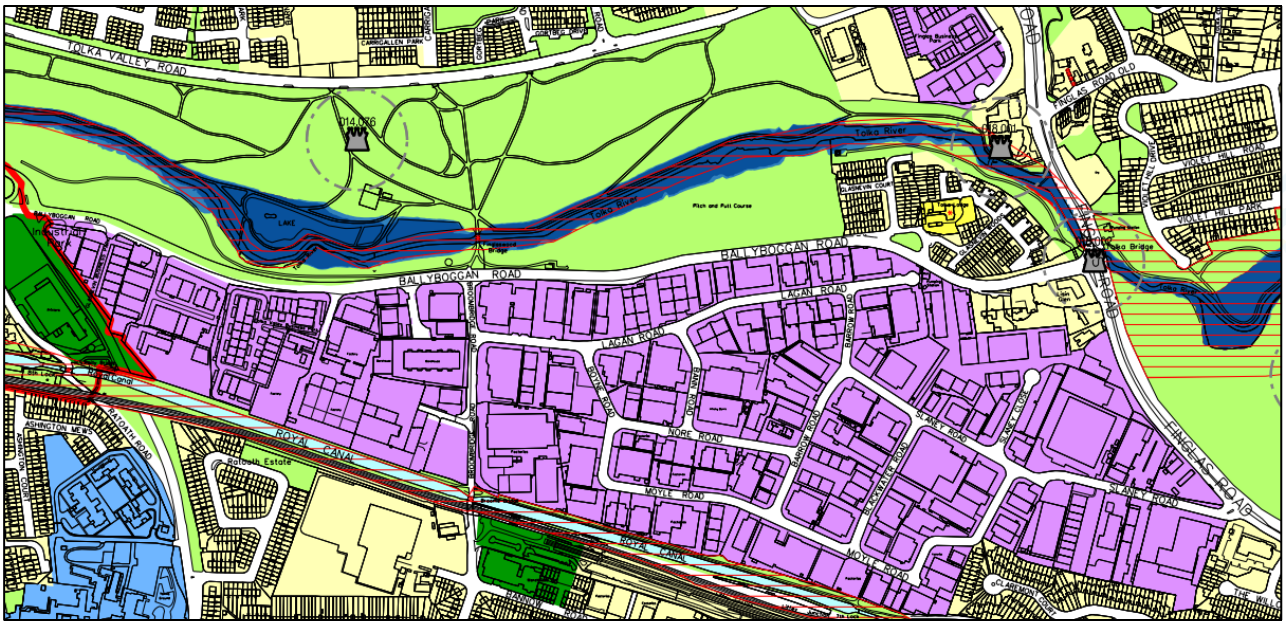

Figure 3-5: Flood Zones from Dublin City Development Plan (CFRAM dataset)

3.6 NIFM

The National Indicative Fluvial Mapping (NIFM) was superseded by the CFRAM study. However, considering the CFRAM maps for the Tolka River are under review, the NIFM maps were consulted and the results are presented in Figure 3-6, showing that the flood extents will encroach on the north-east corner of the Masterplan lands.

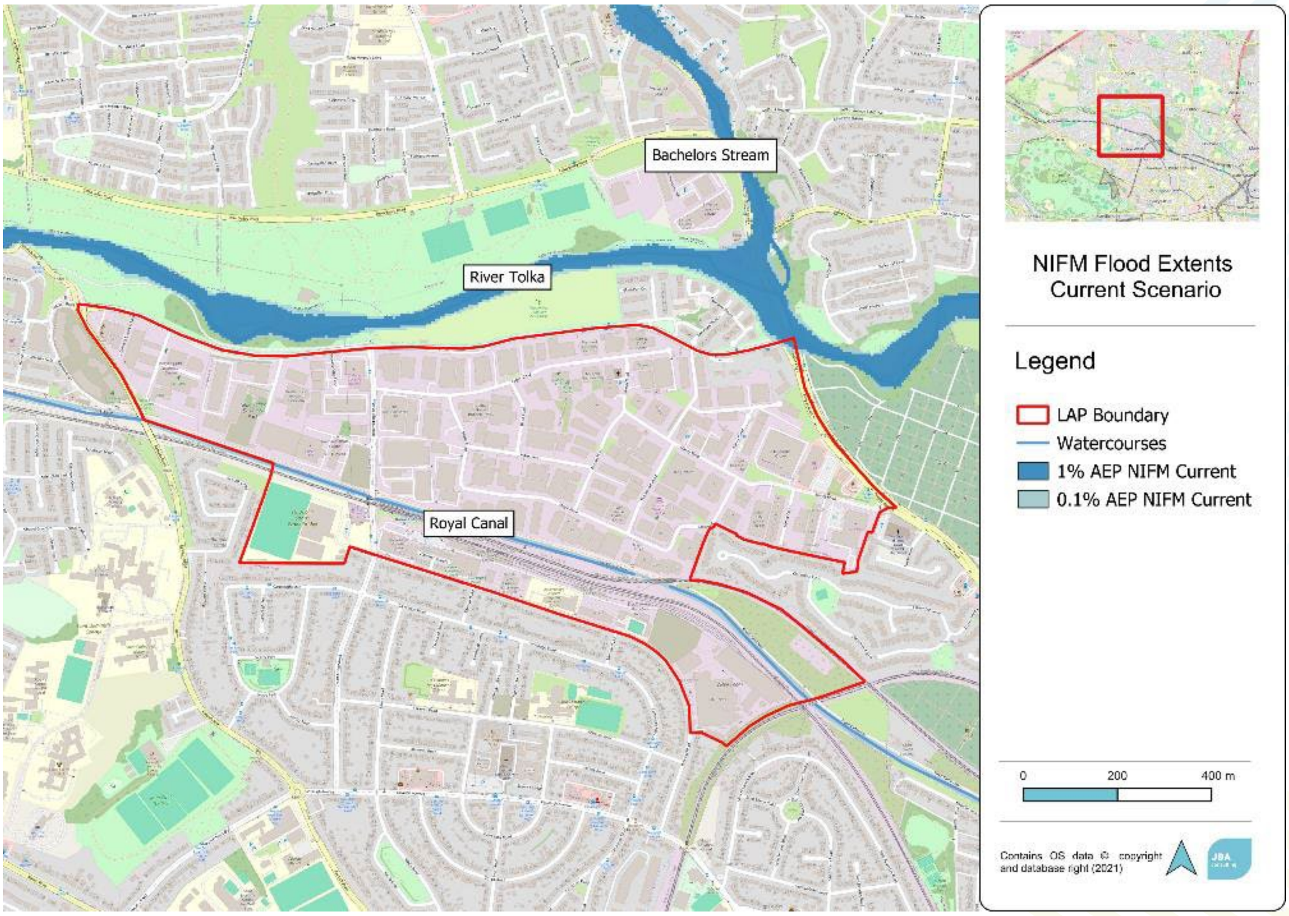

Figure 3-6: NIFM Flood Extents Current Scenario

3.6.1 Climate Change Flood Mapping

Climate change has also been considered during the hydraulic analysis, Figure 3-7 and Figure 3-8 over page includes a representation of the MRFS and HEFS climate change, see Section 1.5.2 for further details on climate change allowances. Due to the steep increase in ground elevation in the north east corner of the site the impact of climate change is very limited.

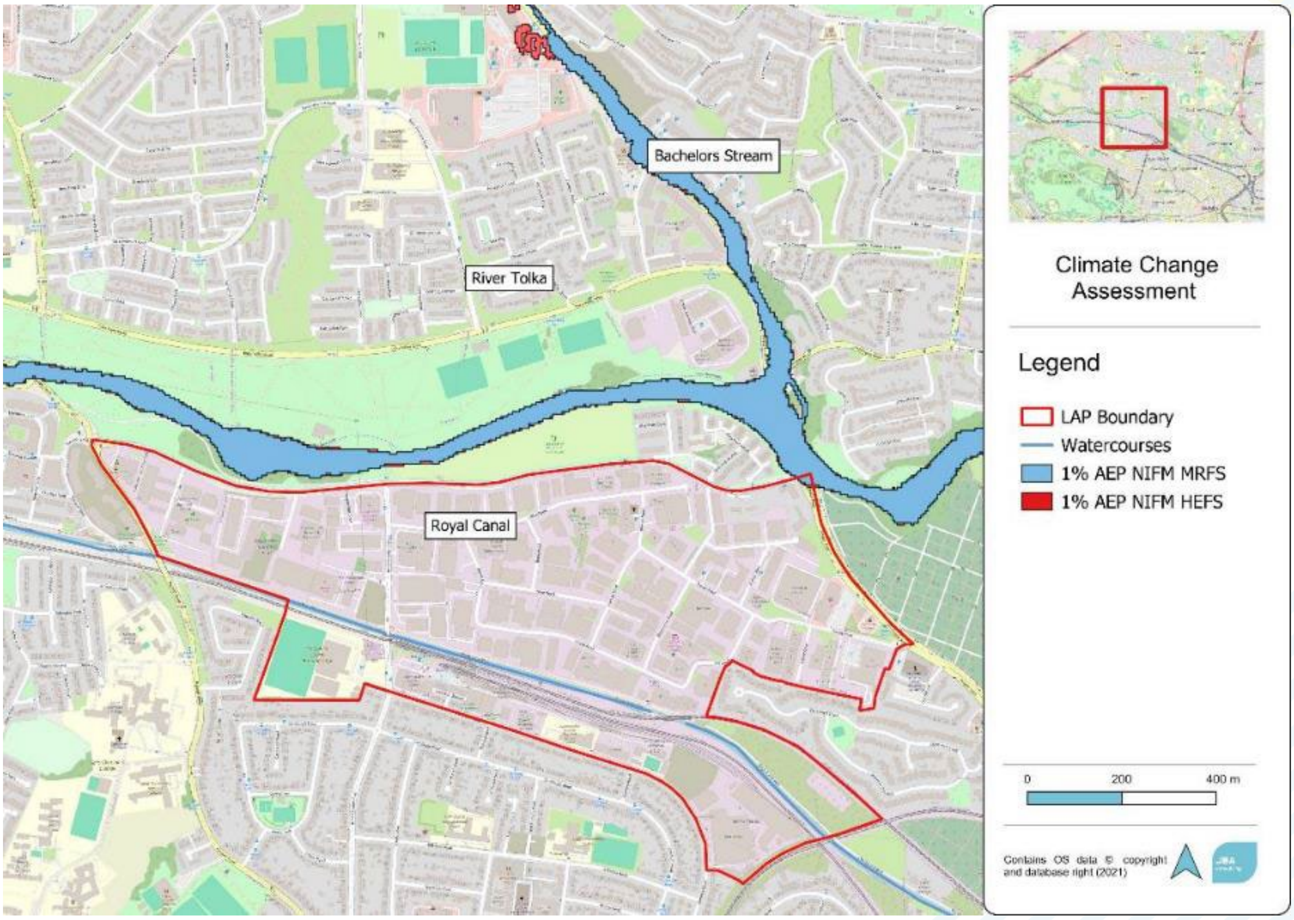

Figure 3-7: River Tolka Climate Change Flood Mapping 1% AEP

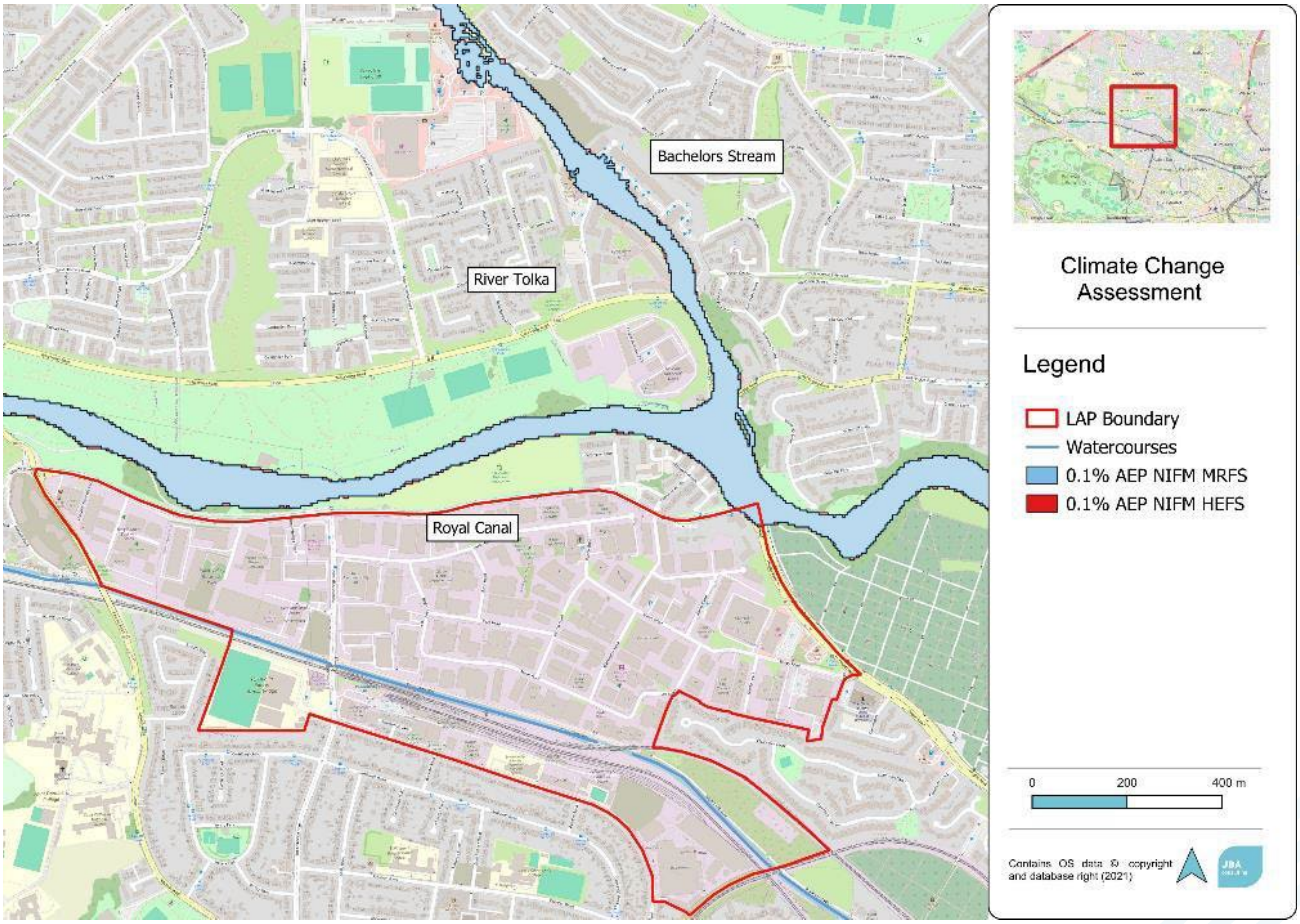

Figure 3-8: River Tolka Climate Change Flood Mapping 0.1% AEP

3.7 Flood Zone Dataset

The Flood Zones for the Masterplan area have been site verified and are comprised of the NIFM dataset.

The Figure 3-9 below presents a zoomed in version of the dataset, focussing on the area of impact within the Masterplan lands.

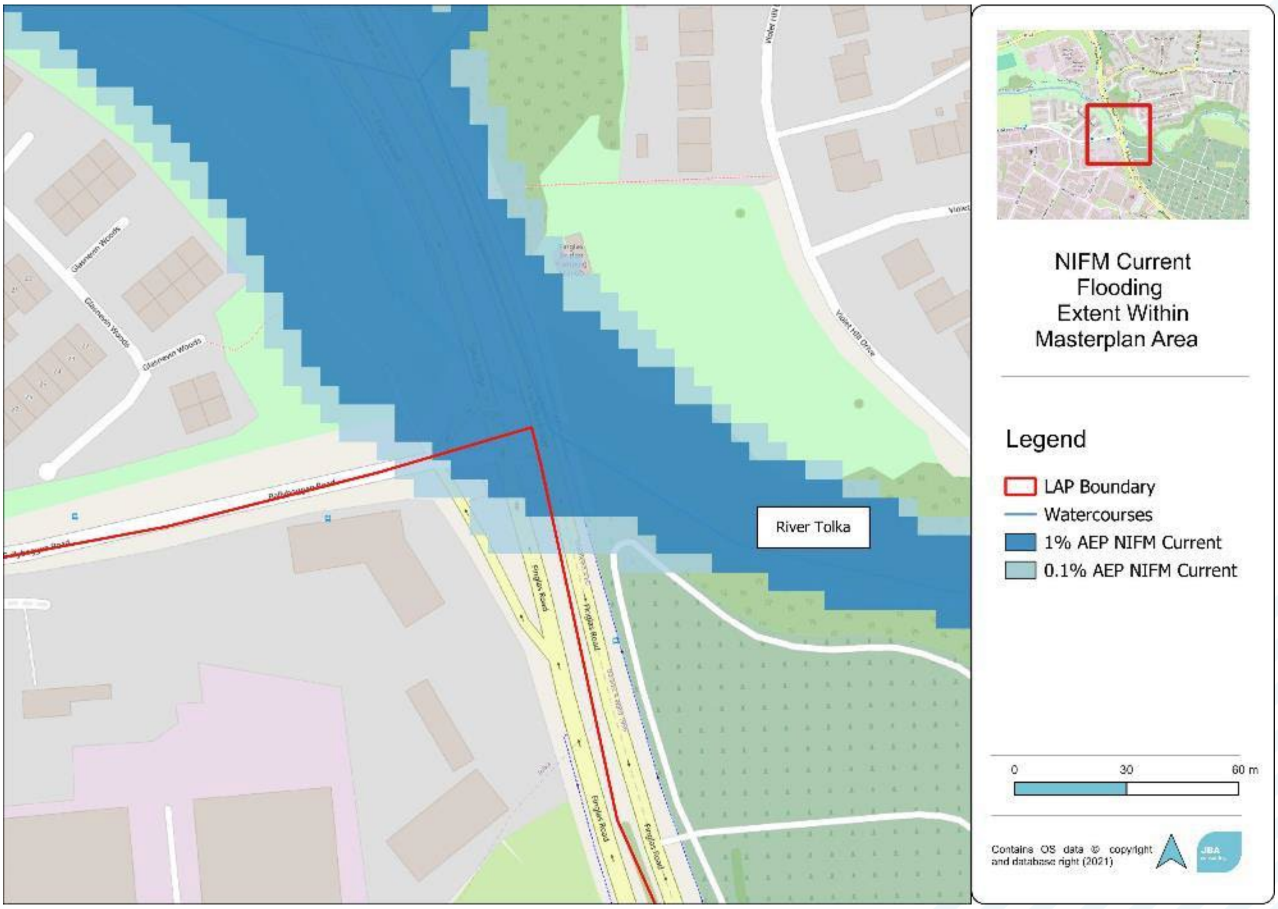

Figure 3-9: Flood Zone mapping

3.8 Sources of Flooding

The Masterplan lands are predicted to have limited impact of fluvial flooding from the River Tolka/Finglas Stream, which affects the far north east corner of the lands. There is some historic risk at this location partly relating to Finglas Stream culvert capacity issues which have now been addressed. The risk from the Tolka itself is represented by indicative NIFM data in lieu of the CFRAM data which has been removed from display. It is likely that the NIFM dataset is overestimating flows, but following the precautionary principle these have been adopted for the representation of the Flood Zones. The impact from climate change is low due to the rapid increase in ground elevation in this corner of the masterplan lands. There is no impact on residential dwellings at this location, only road and green space.

Pluvial flooding is predicted by the FloodResilienCity mapping but it is an identification of topographic depressions and is not a detailed representation of risk as it takes no account of the drainage infrastructure. Further JBA pluvial modelling has been undertaken to estimate areas of potential pluvial flood risk that is driven by a 2D model and represents topographical flow pathways taking into account ground cover and an inclusion for drainage networks. The modelling is still indicative in nature and highlights several areas that will require attention under the RMS for mitigation. This will be dealt with under the RMS and is discussed further in the next section.

Risk from the canal is the residual risk of breach/overtopping. Historically some overtopping has occurred after surface water flowed into the canal and caused overtopping, a breach event is less likely but has been investigated further in the consideration of the Masterplan and development levels (Section 4.2).

Considering other potential residual risks then the potential for blockage of the River Tolka bridges (which are outside the Masterplan boundary) has been screened out because this would only impact upon park lands or limited sections of the R135 Finglas Road at the junction with the Ballyboggan Road.

A review of flood risk and Masterplan development is undertaken in Section 4.

4 Masterplan Review & Mitigation

The purpose of land use zoning objectives is to indicate to property owners and members of the public the types of development the Planning Authority considers most appropriate in each land use category. Zoning is designed to reduce conflicting uses within areas, to protect resources and, in association with phasing, to ensure that land suitable for development is used to the best advantage of the community as a whole.

This section of the SFRA will:

- Outline the strategic approach to flood risk management.
- Consider the land use zoning objectives utilised within and assess their potential vulnerability to flooding.
- Investigate mitigation options for the management of fluvial flood risk to the River Tolka and the residual risk of a Royal Canal breach/overtopping event.
- Summarise the stormwater management approach from the RMS (separate cover).
- Based on the associated vulnerability of the particular use, the Justification Test is applied.

4.1 A Strategic Approach to Flood Risk Management

A strategic approach to the management of flood risk is important in as the risks are varied, with scales of risk and vulnerability varying across the settlement.

Following the Planning Guidelines, development should always be located in areas of lowest flood risk first, and only when it has been established that there are no suitable alternative options should development (of the lowest vulnerability) proceed. Consideration may then be given to factors which moderate risks, such as defences, and finally consideration of suitable flood risk mitigation and site management measures is necessary.

The Masterplan lands are subject to two land use zoning objectives which are presented visually in Figure 4-1;

Z6: Employment Enterprise - To provide for the creation and protection of enterprise and facilitate opportunities for employment creation.

Z1: Sustainable Residential Neighbourhoods - To protect, provide and improve residential amenities.

The Masterplan will set out the development pattern and green space allocation within the Z6 and Z1 areas, redefining the uses, although it is noted that for the Z1 lands these are retaining the existing built form, with the exception of the incorporation o the swale / SuDS feature.

A key objective of the Masterplan SFRA and RMS is to allow for the sustainable management of both pluvial and fluvial flood risk. As such there is the ability to align the open space and general development layout within the Masterplan to support the strategic objectives for flood risk management.

The following sections set out the assessment and management options for the Masterplan.

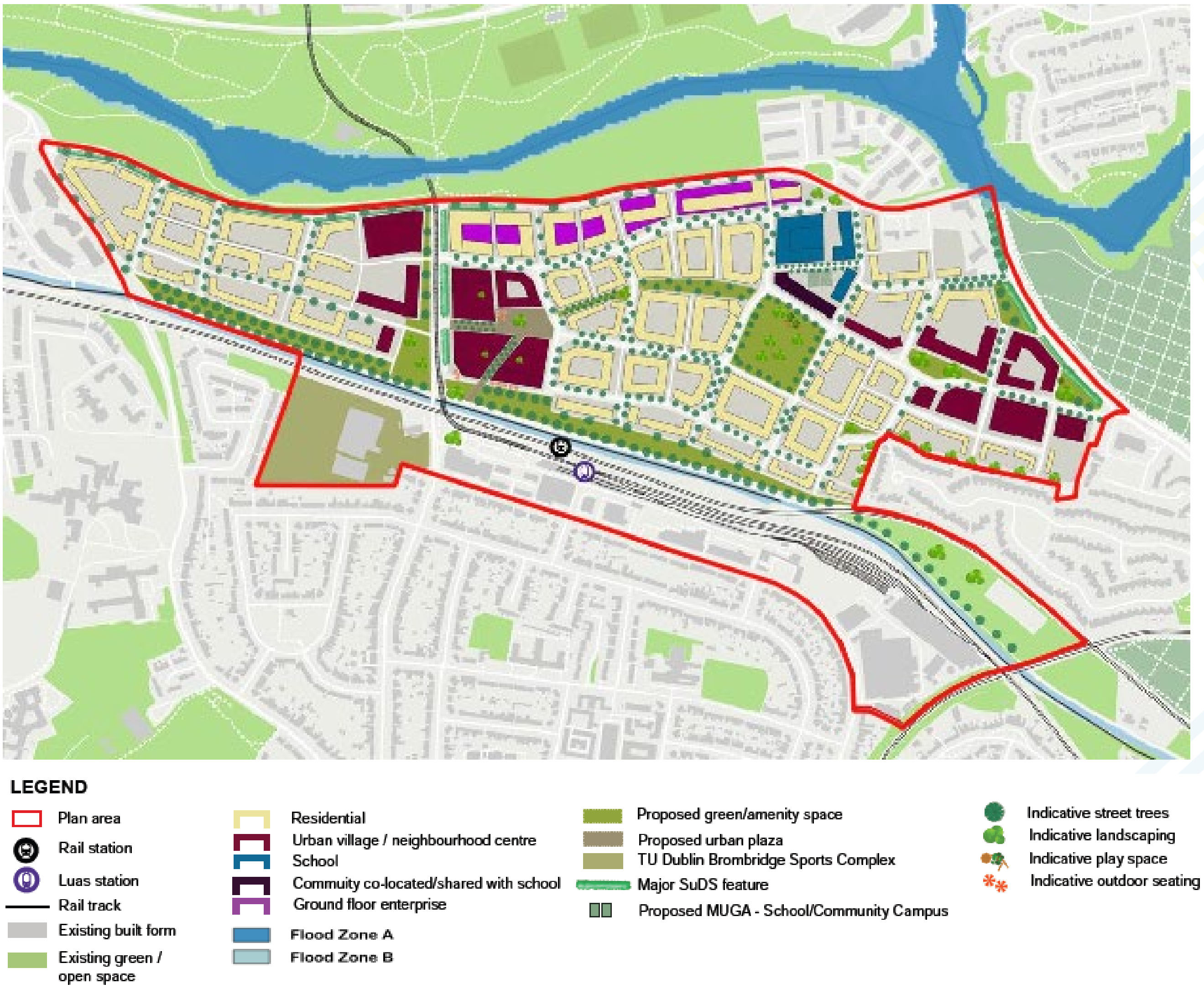

Figure 4-1: Masterplan Zoning Flood Risk Assessment & Mitigation

Referring back to Section 1.3.1 and the parent document of the Dublin City Development Plan and the associated SFRA it is clear the strategic flood risk management strategy for the Masterplan lands necessitates that:

- **Any new development could reasonably be accommodated within the extents of Flood Zone C and should not need to extend into Flood Zone A or B.**
- **Flood Zone A/B incorporates limited road infrastructure and open space under existing use and this will be managed appropriately.**
- **Residual risk of canal overtopping should be considered, with appropriate implementation of mitigation measures.**
- **Recommendations from the RMS and SFRA must be implemented to effectively manage all sources of risk.**

4.2 Rainwater Management Strategy (RMS)

The RMS has identified key constraints, appraised the study area's green infrastructure potential and developed initial land-take requirements for footprint development. It has then taken the intended masterplan footprint and created an integrated surface water conveyance system that complements the intentions of the green infrastructure strategy.

The RMS has divided the Masterplan lands into discrete catchments for the management of rainwater and also considers how much land will need to be assigned to potential stormwater storage (and flow control) as well as aligning Green Infrastructure which incorporates two large swales which form the core of the SuDS strategy. Figure 4-2 displays the swale infrastructure which is of importance to the SFRA as the central swale also assists with a significant potential conveyance route for the management of overland flood risk generated by canal breach (as explained in the next Section). The swale on the eastern extent feeds down into the floodplain of the River Tolka where the Flood Zones impact on the far northeast corner of the site. The design was based on the following rainwater parameters.

Table 4-1 Broombridge-Hamilton rainfall parameters

Broombridge-Hamilton Rainfall Parameters	
M5-60	16.3mm
SAAR	967mm
R RATIO	0.276
SPR	0.47 (Soil Type 4)

The RMS provides both overarching SuDS guidance and site-specific infrastructure elements that complement both the intended layout and the topography and infrastructure constraints of the study area, it is provided under separate cover as part of the overall masterplan.

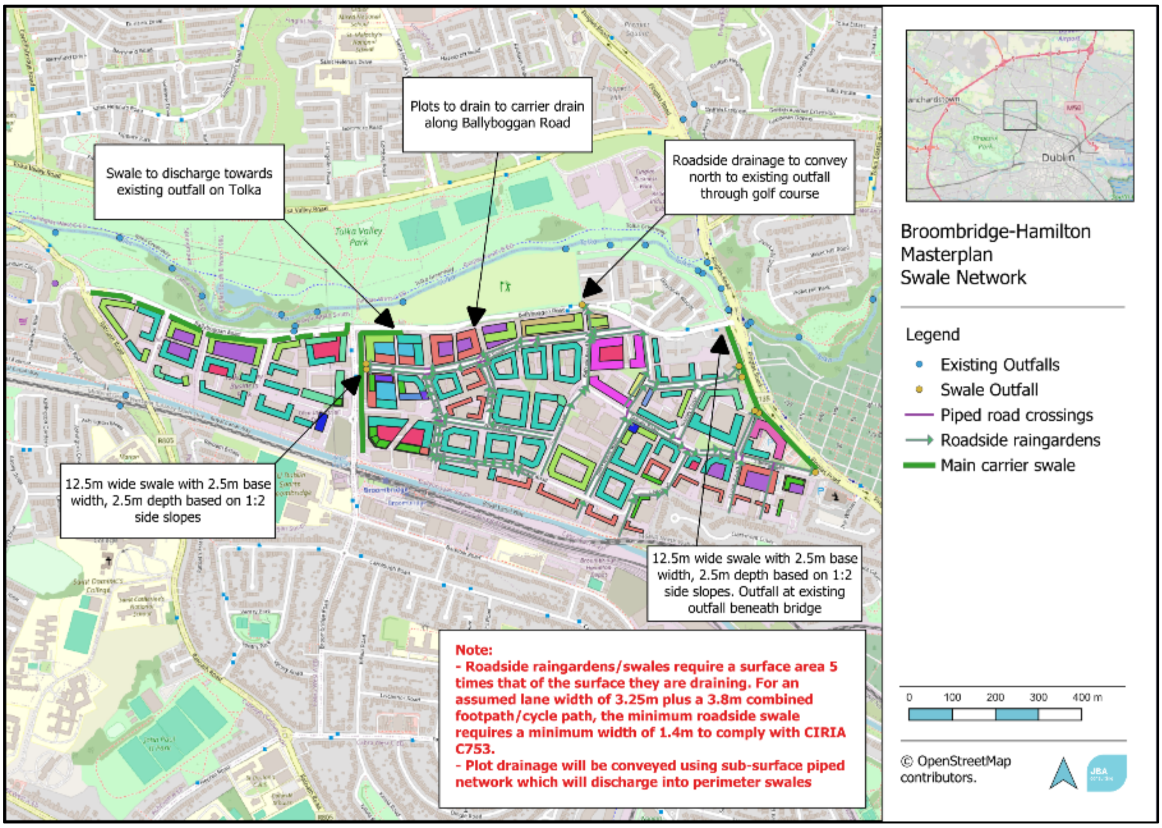

Figure 4-2: Public Realm Swale Infrastructure (taken from the RMS)

4.3 Canal Breach Analysis

To provide residual risk breach consideration for the Royal Canal a hydraulic model was constructed using OPW LiDAR[3] and hydrological estimation of flow volumes. The model runs from Lock 7 at the southwestern corner of the area to Lock 8 at the southeastern corner of the area. The modelling was undertaken using the ESTRY-TuFLOW software package and is sufficient in detail to represent the hydraulic behaviour of the canal. The hydrology has been devised based on the volume of water between Locks 7 and 8.

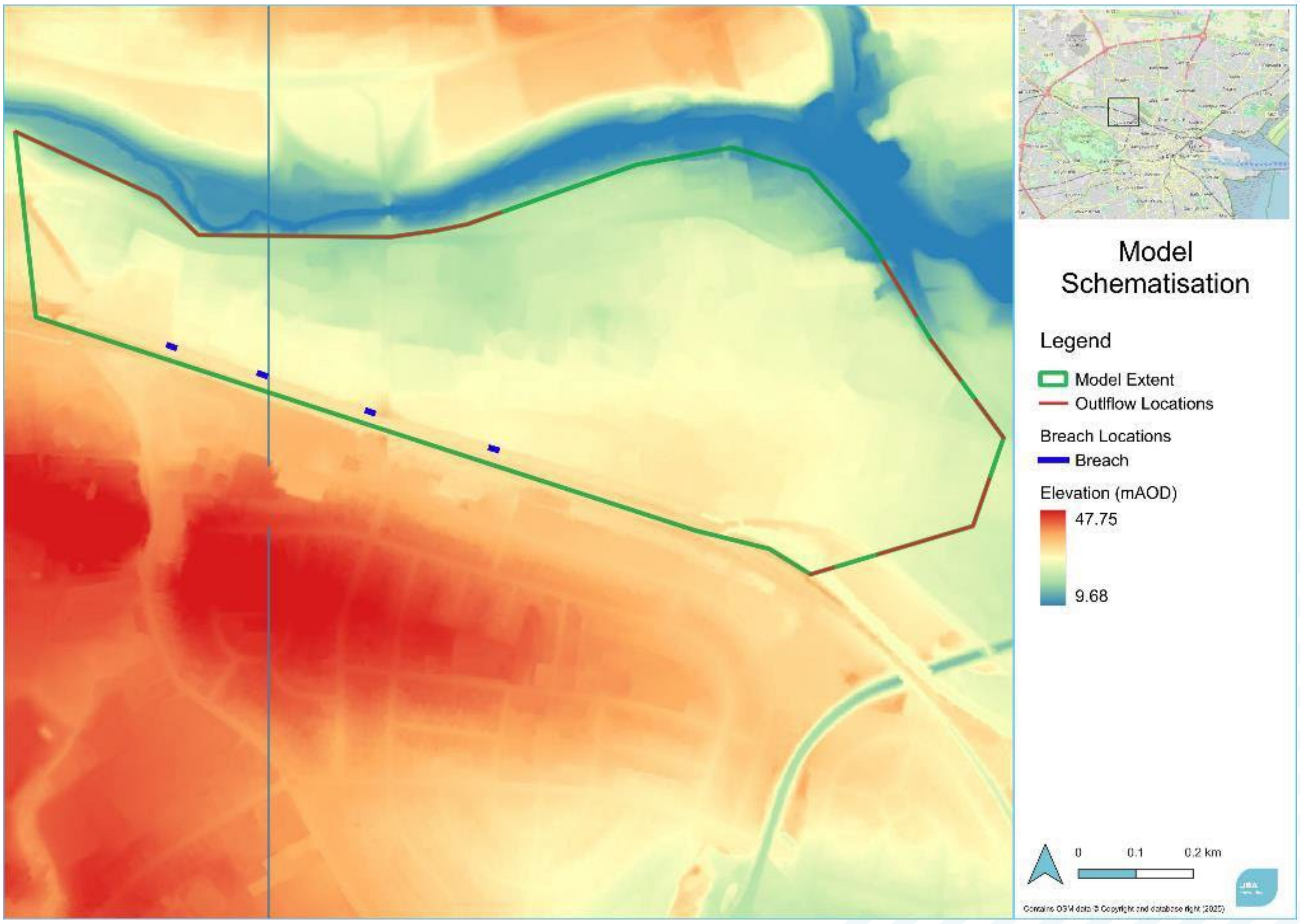

Figure 4-3 2D TuFLOW Model Schematisation

4.4 Model Parameters

Flooding arising from the Royal Canal was simulated via breaches in the canal banks. Based on topography, several locations were chosen to assess the full length of the canal bordering with the development area. A total of 4 breach locations were chosen based on a higher likelihood of bank failure. Further to the east along the canal there is no embankment and therefore no probability of failure.

A conservative approach was adopted which assumed the full volume of the canal between the locks spilled through each breach individually. Breach width was assumed to be 4.5m approximately half the width of the canal, for each location.

Based on an approximate volume of 16,200m^3, the hydrograph representing breach outflow was calculated using the sharp-crested rectangular weir equation. The

[3] Missing data in the OPW LiDAR (seen as a vertical blue line in Figure 4-2) was patched during model simulation to improve accuracy.

hydrograph is shown in Figure below. Peak flow was calculated to be 7.36m^3/s and total hydrograph duration was 74 minutes.

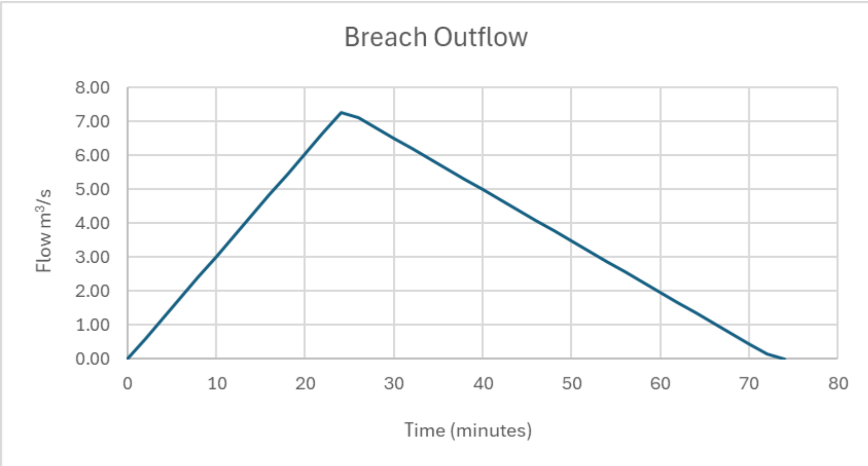

Figure 4-4 Canal breach outflow hydrograph

4.5 Model Results

Results from model simulations show that western parts of the area could be impacted by potential canal breach. Following the natural gradient from south to north, water travels through the site via pathways created by Green Infrastructure and roads towards the Tolka Valley Park at the northern boundary. In general, flood depths average between 0.2 – 0.4m. The large central swale offers a large opportunity to route overland flows with significant potential to route a greater amount of flow down this pathway that currently represented.

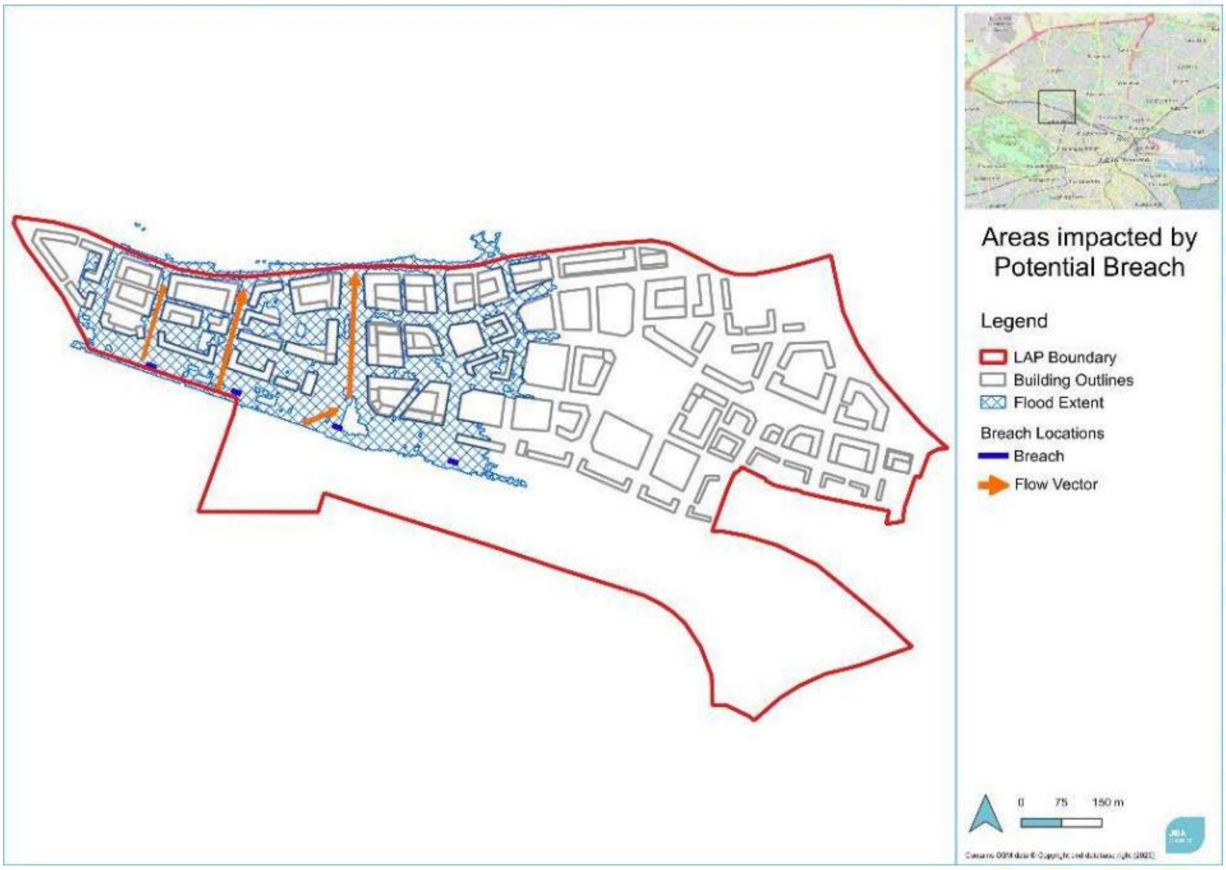

Figure 4-5 Flood extent from potential canal breach showing direction of flows

The strategy for the management of the residual risk of canal breach is as follows;

- Overland flow routes are prioritised along the natural fall of the land to the north towards the Tolka Valley Park.
- Green Infrastructure adjacent to the canal dissipates the initial high velocity/deep flow.
- Shallow overland flow is then prioritised in a northerly direction along Green Infrastructure (swale and LUAS route) or road routes.
- Road corridors typically allow at least 100mm offset to top of kerb, GI elements allow a much greater offset with the central swale adjacent to the LUAS offering circa 2m depth and 12.5m width and significant carrying capacity.
- There is potential to increase the routing through the central swale as the design progresses.
- All building FFLs will also be offset a further margin above hardstanding, typically a further 150mm.
- The canal infrastructure is subject to regular monitoring and maintenance by Waterways Ireland.

As the masterplan progresses and design levels begin to be formulated the strategy can be refined through further modelling and adjustment for final road, GI (swale) and building levels to ensure that the necessary resilience is maintained.

4.6 Settlement Review & Justification Test

Area Description and Flood Risk	The River Tolka flows west to east passing under the R135 Finglas Road to the north east of the Masterplan lands. The Flood Zone dataset indicates that flood extents from the Tolka extend into the north east corner of the Masterplan lands impacting the R135 road junction but not the residential block of flats on the corner of the R135 and the Ballyboggan Road. The ground levels at this location are rising steeply away from the Tolka and this limits the impact of both climate change and the residual risk from bridge blockage at this point, limiting climate and residual risk to this part of the Masterplan lands. The Residential Z1 lands are retaining their existing form and are not being directly altered by the masterplan other than the inclusion of a 12.5m wide swale on the eastern boundary of the lands and this is a water compatible use strategically linking into the Flood Zone A/B. Given that the lands impacted by the flooding are zoned Z1 for the highly vulnerable residential use, the Justification Test must be applied.
Historic Flooding	Historic flooding (Fluvial) is noted in 1984 (fluvial Tolka/Finglas Stream at junction of Ballyboggan Road and R153 Finglas Road) and 2011 (surface water/canal overtopping at Broombridge Station), see Section 3.2.
Climate Change	Under the existing scenario there is low sensitivity to climate change with flood maps presented in Figure 3-7 and Figure 3-8. For surface water risk the proposed future Masterplan layout offers the opportunity to manage increased volumes as a result of climate change in combination with the RMS.
Residual Risk	The residual risk of River Tolka bridge blockage in the north-east corner of the site is low due to the steep increase in ground levels. The impacted area is at the junction of the R135 Finglas Road and the Ballyboggan Road.

	Canal overtopping and breach is discussed in Section 4.2 which also sets out the general strategy for the management of this risk.
Surface Water	There is some potential surface water / pluvial flood risk within the Masterplan lands as shown in Figure 3-4. This will be managed as set out under the Rainwater Management Strategy (RMS) which has taken the intended masterplan footprint and created an integrated surface water conveyance system that complements the intentions of the green infrastructure strategy. It provides both overarching SuDS guidance and site-specific infrastructure elements that complement both the intended layout and the topography and infrastructure constraints of the Masterplan area.
Development Strategy	The Masterplan area is situated in the Dublin MASP's City Centre within the M50 development corridor which is identified for strategic brownfield regeneration. The proposed Masterplan is identified as a priority Local Area Plan under the new City Development Plan in accordance with Objective CSO1. Flood risk from all sources is not a significant constraint on the lands and it is proposed that: • The Royal Canal route is accommodated with an appropriate riparian zone. • The River Tolka Flood Zone A/B impacts a small area of the northeastern corner of the Masterplan lands where the existing form of residential development is being unaltered. • Within Flood Zone A/B on the northeastern corner of the Masterplan lands further Highly vulnerable residential usage will not be developed instead the land is prioritised for use incorporating a 12.5m wide swale/SuDS feature which links along the eastern margin into the Flood Zone. • Canal breach is managed by prioritising shallow overland flow routes along road and GI swale / SuDS corridors in a northerly direction towards the Tolka Valley Park and allowing for an appropriate offset to any building FFLs, as set out in Section 4.2. • Prior to the finalisation of any future detailed design for the Masterplan, a detailed integrated catchment/drainage model and further on site survey is conducted to provide a level of assessment appropriate for the full testing of both the upstream stormwater drainage catchment and the proposed Masterplan lands as part of an updated Flood Risk Assessment. This will allow for the full and detailed design of the Masterplan lands and the more detailed assessment will also allow for the alignment with Policy SI10. • Any future development planning applications within the Masterplan boundary should rely on the updated integrated catchment model and associated FRA and also apply the guidance set out in Section 4 of the Dublin City Council Development Plan SFRA. • The Rainwater Management Strategy (RMS) sets out the plan for the control of surface water run-off and Green Infrastructure. The RMS should be considered in conjunction with the SFRA and the recommendations within the RMS must be applied in tandem. The previous sections of the SFRA and the separate RMS document have demonstrated through hydraulic modelling that the proposed Masterplan arrangement has the potential to mitigate risk from fluvial, canal and stormwater flood risk.
Justification Test for Development Plans 1. **The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.** Answer: The Masterplan area is situated in the Dublin MASP's City Centre within the M50 development corridor which is identified for strategic brownfield regeneration see section 2.4.1 of the Written Statement. Enhanced accessibility will be provided by the rollout of BusConnects enhancements along Finglas Road, Luas extension to Finglas and Dart+ West rail upgrades between	

Maynooth and Connolly Station. The proposed Masterplan lands are identified as a priority Local Area Plan under the City Development Plan in accordance with Objective CSO1: Feasibility Study and Local Statutory Plan for Z6 Zoned Lands at Glasnevin. It is noted that the lands also include: Z1 Sustainable Residential Neighbourhoods in the north east corner and south of the canal and Z10 Inner Suburban and Inner City Sustainable Mixed-Uses south of the canal, which are retaining the existing built form.

2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:

(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement.

Answer: Yes: The lands are located northwest of Dublin city centre and to the south of the nearby Tolka River. The area lies between Cabra and Finglas, halfway between the city centre and the M50 motorway. The Royal Canal traverses the area from east to west. The area is served by Luas and mainline rail at Broombridge. The wider Masterplan lands will be served by the future Luas extension to Finglas and by Bus Connects and have the capacity to accommodate significant new residential and employment development, which aligns the national and regional policy for compact growth, while supporting the principles of transport orientated development (TOD), set out in the NPF and RSES respectively.

The lands are currently zoned Z6 for employment and enterprise. Residential development is not permitted in the Z6 zone. Therefore, in order to facilitate the regeneration of these lands, a Masterplan was prepared. Following a consultation process and approval by the elected members, a Variation is now proposed. This Variation will change the zoning of the lands to Z14 Strategic Development and Regeneration Area (SDRA) and will incorporate the Masterplan by way of a new SDRA. At this stage the plan will be statutory.

The area impacted by Flood Zone A/B is currently characterised by a small pocket of Z1 residential development subject to zoning objective Z1 – Sustainable Residential Neighbourhoods. The lands also form part of the Masterplan lands (proposed SDRA). The River Tolka only affects open space and the junction area of the R135 Finglas Road and Ballyboggan Road, impacts do not extend to the existing residential apartments/houses.

- The residual risk of bridge blockage does not extend to the existing buildings and would only impact the road junction area, which is already in Flood Zone A/B.

The area is considered essential to facilitate the regeneration and expansion of the urban settlement along a strategic transport corridor. Outside the masterplan lands, there is limited large scale regeneration sites within this area.

The proposed SDRA lands also includes Z9 (Amenity/Open Space Lands / Green Network) and Z11 (Waterways Protection). No changes to the function or use of these lands are proposed.

(ii) Comprises significant previously developed and/or under-utilised lands

Answer: Yes. The lands located within Flood Zone A/B are already built-up and the existing form will not be adjusted. Any future redevelopment would occur within Flood Zone C in accordance with the Dublin City Development Plan 2022-2028 and its SFRA. The lands subject to the urban framework are currently zoned Z6. These lands are identified as a priority Local Area Plan under the Dublin City Development Plan 2022-2028 in accordance with Objective CSO1: Feasibility Study and Local Statutory Plan for Z6 Zoned Lands at Glasnevin. These lands are considered to be underutilised and have the potential to contribute towards achieving national and regional compact growth objectives and facilitate sustainable urban development. A rezoning of these lands to Z14 is required in order to implement the urban framework set out in the Masterplan.

(iii) Is within or adjoining the core of an established or designated urban settlement.

Answer: Yes: The lands are situated to the west of Glasnevin, north of Cabra and to the south of Finglas, which is designated as a Key Urban Village in the Development Plan. The RSES includes the Dublin Metropolitan Area Strategic Plan (MASP). The Masterplan lands are situated in the Dublin MASP's City Centre within the M50 development corridor which is identified for strategic brownfield regeneration. See

section 2.4.1 of the Written Statement. To enable the implementation of the urban framework set out in the Masterplan, re-zoning of the Z6 lands to Z14 is required. **(iv) Will be essential in achieving compact and sustainable urban growth.** Answer: Yes: (see response to (iii) above). **(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.** Answer: There are no suitable alternative lands for the particular uses or development type in areas at lower risk of flooding, within or adjoining the urban settlement. The area of the Masterplan identified in Flood Zone A and B to the north east is small and is already developed. This was subject to the SFRA undertaken as part of the current Development Plan. There will be no further highly or less vulnerable development within Flood Zone A/B. **3. Specific Flood Risk Assessment** This SFRA has set out the strategic approach to development and how the Masterplan lands can incorporate a sustainable approach to fluvial and stormwater management. In applying the guidance set out in the Dublin City Development Plan Section 9.5.2 and 10.5.5 it has been demonstrated to an appropriate level of detail that flood risk to the Z1 zoned area can be adequately managed and the development of the lands will not cause unacceptable adverse impacts elsewhere. It is recommended that the development strategy is followed and that the lands within Flood Zone A/B are retained as an appropriate water compatible use, as set out in the Masterplan layout.
Conclusion: The Masterplan (proposed Variation) passes the Justification Test for Development Plans.

5 SFRA Review

5.1 Triggers for Review

An update to the SFRA will be triggered by the review cycle that applies to local authority Development Plans, under which this Masterplan sits. In addition, there are a number of other potential triggers for an SFRA review which may include any publication of revised flood mapping for the River Tolka by the OPW under their Map Review programme.

Not all future sources of information should trigger an immediate full update of the SFRA; however, new information should be collected and kept alongside the SFRA until it is updated.

Most importantly the recommendation for the more detailed integrated catchment/drainage model and further on site survey and associated FRA will trigger a review of the SFRA.

5.2 Conclusion

This SFRA has been developed to inform the preparation of the Broombridge-Hamilton Masterplan, which has been reviewed against the recommendations set out in The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009 and the Dublin City Development Plan 2022-2028. The land-use zoning allocation and general strategy of the Masterplan has passed parts 1 and 2 and 3 of the Justification Test, with further recommendations made in part 3 of the Justification Test, relating to further assessment/FRA prior to detailed design.

JBA consulting