South Dublin County Council
Development Plan
2016 – 2022

Proposed Variation No.3

Zoning Objective Amendment on Lands at Ballymount / Naas Road

Strategic Flood Risk Assessment (SFRA)

Comhairle Contae
Átha Cliath Theas
South Dublin County Council

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Revision History

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Contract

This report describes work commissioned by Jason Frehil, on behalf of South Dublin County Council, by a letter dated 31st October 2018. SDCC's representative for the contract was Eoin Burke of the Planning Department of SDCC. Ross Bryant and Jonathan Cooper of JBA Consulting carried out this work.

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Purpose

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Abbreviations

AEP ..... Annual Exceedance Probability

CAD ..... Computer Aided Design

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

DTM..... Digital Terrain Model

FEH ..... Flood Estimation Handbook

FSU ..... Flood Studies Update

GDSDS ..... Greater Dublin Strategic Drainage Strategy

GIS ..... Geographical Information System

GSI ..... Geological Survey of Ireland

Ha ..... hectares

IW ..... Irish Water

JBA..... JBA Consulting

LiDAR..... Light Detection And Ranging

l/s ..... litres per second (flow rate or capacity)

m ..... metres

m^3..... cubic metres (volume)

m/s ..... meters per second (flow velocity)

m^3/s..... cubic meters per second (flow rate or capacity)

mOD ..... Meters above Ordnance Datum

OPW ..... Office of Public Works

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

SDCC..... South Dublin County Council

SWMP..... Stormwater (or surface water) Masterplan

TUFLOW ..... Two-dimensional Unsteady FLOW (a hydraulic model)

WRAP ..... Winter Rainfall Acceptance Potential

2D..... Two Dimensional (modelling)

1 Introduction

1.1 Terms of Reference

JBA Consulting was appointed by South Dublin County Council to carry out the Strategic Flood Risk Assessment for Proposed Variation No. 3 of the South Dublin County Council Development Plan 2016 – 2022 (referred to as the County Development Plan).

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; these guidelines were issued under the Planning and Development Act 2000, and recognise the significance of proper planning to manage flood risk.

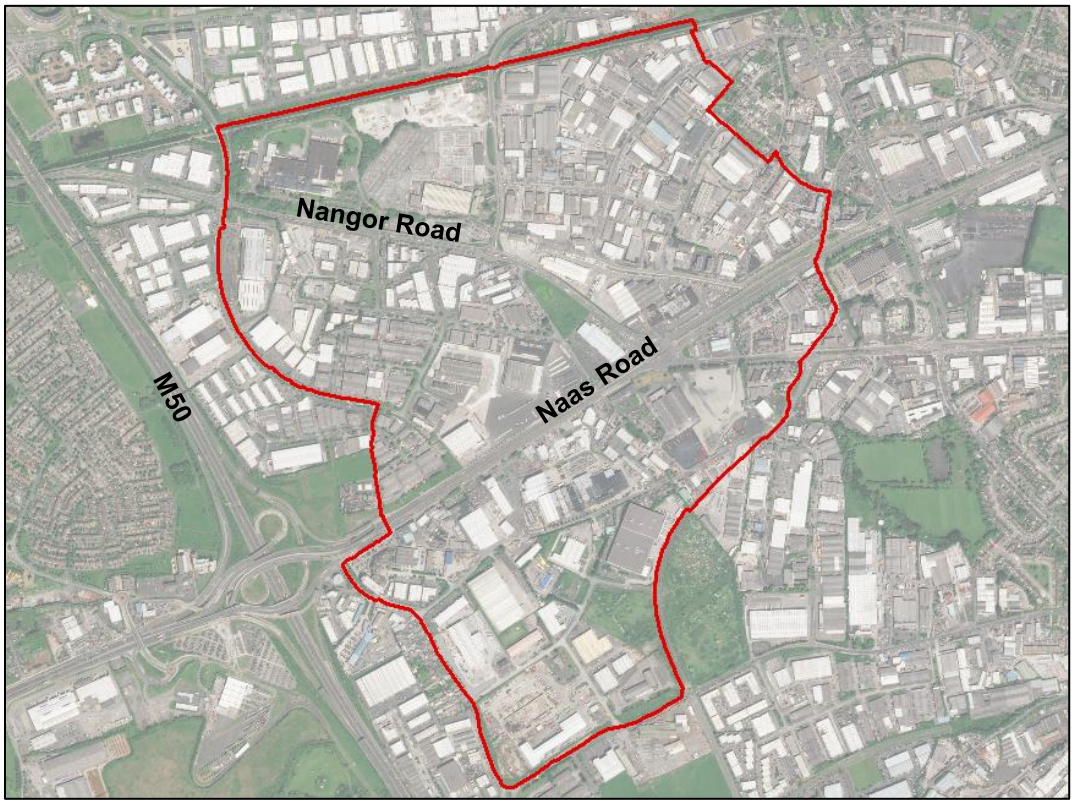
1.2 Background

South Dublin County Council intends to initiate a Proposed Variation No.3 to the County Development Plan under Section 13 of the Planning and Development Act 2000 (as amended). The proposed variation consists of three elements:

1. Replace existing Enterprise and Employment (Industrial) zoning with Regeneration (mixed use) for 178ha of land.
2. Amend the Core Strategy accordingly (Tables 1.9 and 1.10 of the CDP).
3. Amend Specific Local Objective (CS6 SLO 1) of the County Development Plan (Page 24 and Map No.5)

   To initiate a plan led approach to the sustainable regeneration of the brownfield lands in the Naas Road / Ballymount REGEN zoned lands. The plan led approach will include the preparation of a masterplan in 2019 with a view to preparing a Local Area Plan or other appropriate mechanism for the REGEN and LC zoned lands. The Naas Road Framework Plan (2010) to be taken into consideration during the preparation of the masterplan.

Figure 1-1:- Naas Road Ballymount Boundary



1.3 Scope of Study

Under the Planning System and Flood Risk Management Guidelines (OPW/DoEHLG, 2009) referred to as the Guidelines, the purpose for the SFRA is detailed as being "to provide a broad (wide area) assessment of all types of flood risk to inform strategic land-use planning decisions. SFRAs enable the LA to undertake the sequential approach, including the Justification Test, allocate appropriate sites for development and identify how flood risk can be reduced as part of the development plan process".

The proposed Variation No. 3 changes are the beginning of a process that will set out a masterplan for the re-development of the Naas Road / Ballymount area.

It is important that the initial phase of work under the Variation fulfils the requirements of the Guidelines which states that flood risk management should be integrated into spatial planning policies at all levels to enhance certainty and clarity in the overall planning process.

To ensure that flood risk is integrated into the Variation process, the main requirements of this document are to:

- Produce Flood Mapping using best available data.
- Prepare a Stage 1 & 2 - Flood Risk Assessment of the area (as defined in the OPW/DoEHLG Guidelines) in relation to the change from EE to REGEN land use zoning.
- Provide guidance on the future scope/objectives for the successful delivery of a masterplan for the REGEN lands
- Prepare a Flood Risk Management Plan summarising the above detail that is in compliance with OPW/DoEHLG – "The Planning System and Flood Risk

Management –Guidelines for Planning Authorities (OPW/DoEHLG, 2009)" and Circular PL02/2014 (August 2014).

- Advise, assess and report on any submissions received as part of both the preparation and the public consultation stage of the plan, as they relate to flood risk.

It is important to note at the outset that the SFRA does not set out at this stage to make any adjustments to the REGEN zoning objective in relation to conflicts with Flood Zone A or B. The purpose of the SFRA is to identify the key areas at risk and outline the requirements for the next phases of work on the masterplan.

1.4 Report Structure

The context of flood risk in The Naas Road Ballymount area is considered with specific reference to fluvial and pluvial flooding, with reference also to secondary sources such as, canal, groundwater and sewer flooding.

Section 2 of this report introduces the study area and Section 3 discusses the concepts of flooding, Flood Zones and flood risk as they are incorporated into the Planning System and Flood Risk Management.

In Section 4 the available data related to flooding is summarised and appraised and outlines the sources of flooding to be considered, based on the review of available data.

Following this, Section 5 provides guidance and suggested approaches to managing flood risk to development; the contents of this section will be of particular use in informing the policies and objectives within the Variation – it is these that will outline the requirements for the next phases of work on the masterplan.

2 Naas Road / Ballymount Study Area

2.1 Introduction

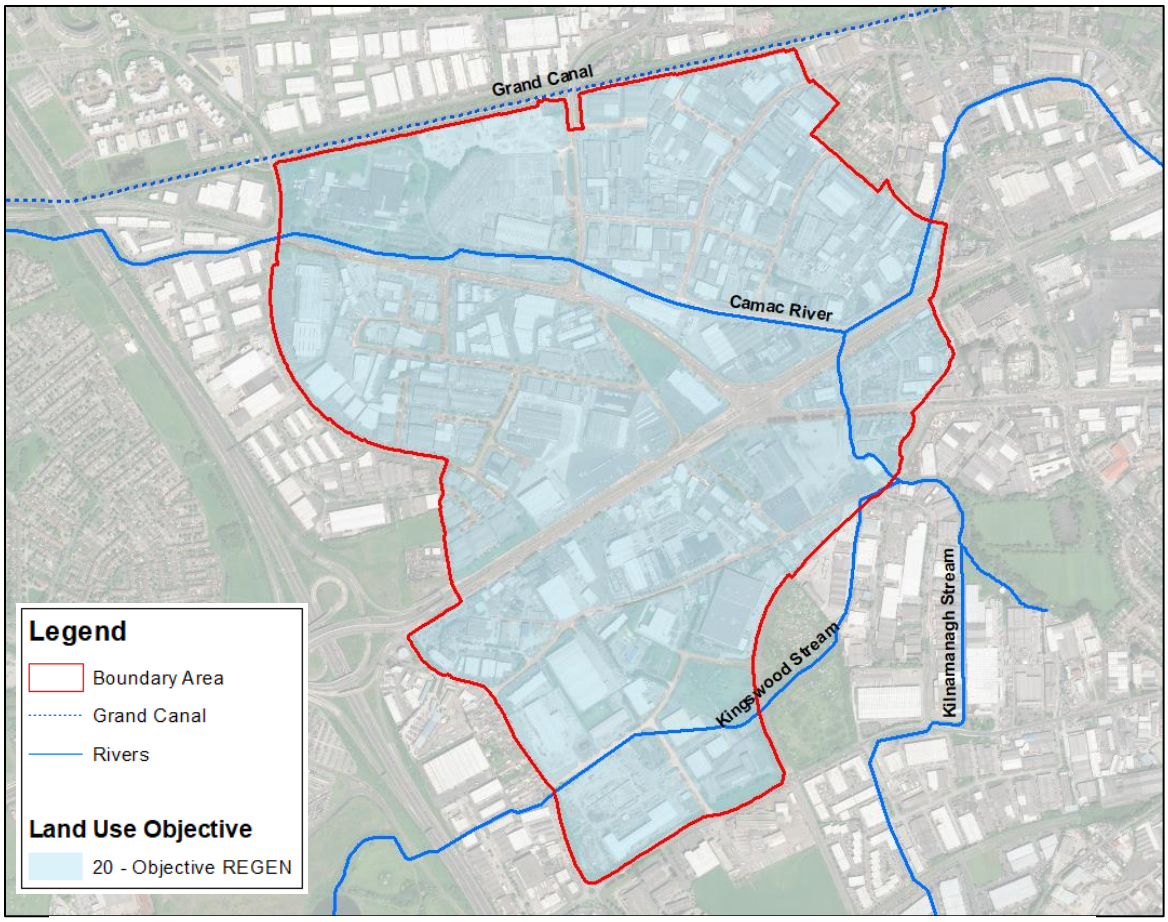
The key issue for the SFRA to address is the zoning of a further 178 hectares of the Employment and Enterprise (EE) zoned lands in the Naas Road / Ballymount area for Regeneration (REGEN).

Through the 'REGEN' zoning objective, South Dublin County Council seeks to facilitate the regeneration of existing brownfield lands, close to existing and proposed transport nodes, to provide for a more intensive mix of enterprise and/or residential led development.

By definition the adjustment from enterprise & employment (a less vulnerable land use) to mixed use (which includes highly vulnerable use) means that the level of potential flood risk will immediately increase, and it is the purpose of this SFRA to define those areas and how the risk will be managed in future plans.

The aim is to transform this brownfield area of national significance into a sustainable, vibrant, mixed use urban quarter that capitalises on its strategic location, creating a sense of identity and place that reaches out and connects with the surrounding urban context. The area is a key transformation opportunity to support the compact development of our cities in accordance with the National Planning Framework (NPF). Figure 2-1 below provides an overview of the study area, zoning and watercourses.

Figure 2-1: Boundary Area for Zoning Amendment and Watercourses



World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2.2 Watercourses

2.2.1 Camac River

The Camac River is the second largest of three main tributaries of the River Liffey, the catchment is circa 40km^2 prior to the confluence with the Kingswood stream and it flows from the foothills of the Wicklow Mountains into the Liffey via a large culvert at Heuston Station. The catchment is heavily urbanised in its lower reaches, particularly through the study area where it passes in an easterly direction through numerous culverts (many of which present a blockage risk). There are also notable tributaries that enter the system within the study area (the Kilnamanagh & Kingswood Streams) as well as a significant urban surface water network draining into the watercourse. The Camac River and tributaries are shown in Figure 2-1.

2.2.2 Kingswood Stream

The Kingswood Stream, refer Figure 2-1, rises in Kingswood approximately 1.6km to the west of the site boundary and has a catchment area of 3.2km^2 which rises to circa 7km^2 after the Walkinstown & Kilnamanagh Streams flow into it. Inside the M50 the catchment is heavily urbanised with multiple culverts and urban surface water inputs.

2.2.3 Kilnamanagh and Walkinstown Streams

The Kilnamanagh Stream rises just outside of the M50 in Kilnamanagh and flows in a north easterly direction into the Camac River by John F Kennedy Industrial Estate. The catchment area is circa 2km^2 including the Walkinstown Stream which flows for a total length of circa 250m before entering Kilnamanagh Stream. The Kilnamanagh Stream flows into the Kingswood Stream just outside the study boundary, however overland flow input from these streams could have an impact within the study area.

2.2.4 Grand Canal

The Grand Canal provides the northern boundary to the site boundary (see Figure 2-1). The canal is predominantly situated at grade with the local area, but is raised circa 2m above surrounding lands in the north east corner of the site boundary.

The canal was opened to cargo boat traffic on February 2, 1779 and the first passenger service began in 1780 between Dublin and Sallins. The introduction of the railways brought about a decline in traffic, and the last boats were withdrawn in 1959-60. The canal is now operated as a leisure amenity and is owned and administered by Waterways Ireland. The study area is bound by the 6th and the 8th Lock, but only the 7th Lock is within the red line boundary. As far as JBA is aware, there are no formal outflows from the canal adjacent or within the study area.

2.3 Environment

The lands primarily consist of brownfield lands with a predominant pattern of low intensity industrial/ warehousing/ car sales uses on a variety of plot sizes.

The Grand Canal is a proposed Natural Heritage Area (pNHA). This is a designation of national importance under the Wildlife Act 2000. A proposed Natural Heritage Area enjoys statutory protection under the County Development Plan. Though the area itself does not include a Natura 2000 site it is connected by pathways to Natura 2000 sites, (e.g. the Grand Canal flows into South Dublin Bay and River Tolka Estuary SPA)

Under Article 6(3) of the EU Habitats Directive, an "appropriate assessment" (AA) is required where any plan or project, either alone or 'in combination' with other plans or projects, could have an adverse effect on the integrity of a Natura 2000 site.

The management of flood risk within such areas must have regard to potential negative impacts to this environment. Further information is provided in the SEA Environmental Report and AA Stage One Screening Report, which are both available as separate documents under the Variation.

2.4 Planning Policy – South Dublin County Council Development Plan 2016 - 2022

The current plan covers the period 2016-2022. The plan sets out compliance with national spatial strategy and the Greater Dublin Area Regional Planning Guidelines, including; "policies for the protection of areas at risk from flooding."

The flood management policies of South Dublin County Council, as laid out in the development plan are as follows:

- To support and co-operate with the Office of Public Works in delivering the Catchment-Based Flood Risk Assessment and Management Programme and in particular the Eastern District CFRAMS and associated Flood Risk Management Plan (FRMP), the River Dodder CFRAMS and associated Flood Risk Management Plan (FRMP). The recommendations and outputs arising from the CFRAM study for the Eastern District shall be considered in preparing plans and assessing development proposals;
- To support the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks and the Flood Risk Regulations (SI No 122 of 2010);
- To manage flood risk in the County in accordance with the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities, DECLG and OPW (2009) and Circular PL02/2014 (August 2014), in particular when preparing plans and programmes and assessing development proposals. For lands identified as being at risk of flooding in (but not limited to) the Strategic Flood Risk Assessment, a site-specific Flood Risk Assessment to an appropriate level of detail, addressing all potential sources of flood risk, is required, demonstrating compliance with the aforementioned Guidelines or any updated version of these Guidelines, paying particular attention to residual flood risks and any proposed site specific flood management measures. Ensure that all development proposals comply with the requirements of the Planning System and Flood Risk Management-Guidelines for Planning Authorities' (DEHLG and OPW 2009) and to ensure that the Justification Test for Development Management is applied to required development proposals and in accordance with methodology set out in the Guidelines;

In addition, Local area plans or other land use plans or policies shall be subject to a flood risk assessment as appropriate in accordance with the Flood Risk Guidelines (2009). Table 2-1 below shows an extract in relation to the study area in the SFRA for the County Development Plan. This is effectively the existing Flood Risk Management Plan for the study area. These policies will be reviewed and revised as part of the Flood Risk Management Plan for Proposed Variation No. 3 (see Section 5).

Table 2-1: CDP Recommendations relevant to the study area (extract from Table 6-1 SFRA for SDCC Development Plan)

Area	Sequential Approach to Land Use Zoning	FRA Minimum Requirements
Existing Less Vulnerable Development • Greenogue • New Nangor Road & Naas Road Area	Existing Industrial, impracticable to rezone for less vulnerable uses. Justification Test applied, and zoning maintained. Specific flood risk assessment measures will apply to development in these sites.	• The New Nangor Road and Naas Road areas were initially identified as possible residential regeneration areas but due to the associated flood risk it was deemed appropriate to retain the existing land use as an industrial zoning. • Existing open spaces and water compatible uses in Flood Zones A and B should be retained to maintain flood storage areas. • New less vulnerable development should be avoided in Flood Zone A. • FRAs for developments should demonstrate that finished floor levels are designed for the 1% AEP (1 in 100 year) flood level plus an allowance for climate change and a minimum freeboard of 300mm. FRAs should also examine residual risk associated with culvert blockages, defence failure and climate change to set finished flood levels where appropriate. The FRAs should ensure development does not block flow paths, does increase flood risk elsewhere, is designed to appropriate standard of flood resilient construction and demonstrates emergency evacuation procedures during flood events. • FRAs should also address surface water management for development, demonstrating consideration of GDSDS policies and incorporation of SuDS e.g. Green Roofs, Rainwater Harvesting, Permeable Surfacing and Swales. • Additional development such as extensions or changes of use can generally be considered appropriate, but an appropriately detailed flood risk assessment will be required in support of any planning application. The level of detail will vary depending on the risks identified and the proposed land use. The FRA should be aimed at setting finished floor levels and demonstrating no increase in flood risk elsewhere.

3 The Planning System and Flood Risk Management

3.1 Introduction

Prior to discussing the management of flood risk, it is helpful to understand what is meant by the term. It is also important to define the components of flood risk to apply the principles of the Planning System and Flood Risk Management in a consistent manner.

The Planning System and Flood Risk Management: Guidelines for Planning Authorities, published in November 2009, describe flooding as a natural process that can occur at any time and in a wide variety of locations. Flooding can often be beneficial, and many habitats rely on periodic inundation. However, when flooding interacts with human development, it can threaten people, their property and the environment.

This Section will firstly outline the definitions of flood risk and the Flood Zones used as a planning tool; a discussion of the principles of the planning guidelines and the management of flood risk in the planning system will follow.

3.2 Definition of 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

The assessment of flood risk requires an understanding of the sources, the flow path of floodwater and the people and property that can be affected. The *source - pathway - receptor model, shown below in* Figure 3-1*,* illustrates this and is a widely used environmental model to assess and inform the management of risk.

Figure 3-1 Source Pathway Receptor Model

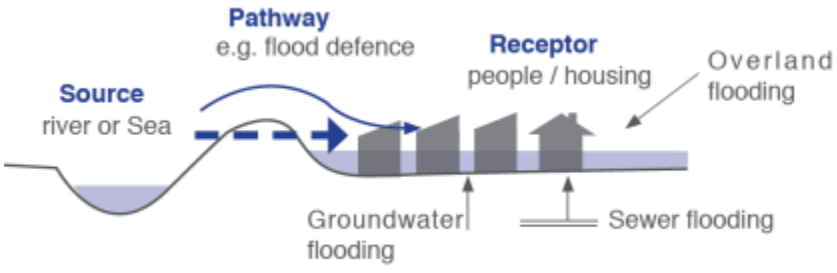


Fig. A1: Sources, pathways and receptors of flooding

Source: Figure A1 The Planning System and Flood Risk Management Guidelines Technical Appendices

Principal sources of flooding are rainfall or higher than normal sea levels while the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets. Receptors can include people, their property and the environment. All three elements must be present for flood risk to arise. Mitigation measures, such as defences or flood resilient construction, have little or no effect on sources of flooding but they can block or impede pathways or remove receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk.

3.2.1 Likelihood of Flooding

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

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 3-1.

Table 3-1 Probability of Flooding

Return Period (Years)	Annual Exceedance Probability (%)
2	50
100	1
200	0.5
1000	0.1

Considered over the lifetime of development, an apparently low-frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 22% (1 in 5) chance of occurring at least once in a 25-year period - the period of a typical residential mortgage;
- And a 53% (1 in 2) chance of occurring in a 75-year period - a typical human lifetime.

3.2.2 Consequences 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.

3.3 Definition of Flood Zones

In the 'Planning System and Flood Risk Management', Flood Zones are used to indicate the likelihood of a flood occurring. These Zones indicate a high, moderate or low risk of flooding from fluvial or tidal sources and are defined below in Table 3-2.

It is important to note that the definition of the Flood Zones is based on an **undefended scenario** and does not consider 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.

It is also important to note that the Flood Zones indicate flooding from fluvial and tidal sources and do not take other sources, such as groundwater or pluvial, into account, so an assessment of risk arising from such sources should also be made.

Table 3-2 Definition of Flood Zones

Zone	Description
Zone A High probability of flooding.	This zone defines areas with the highest risk of flooding from rivers (i.e. more than 1% probability or more than 1 in 100) and the coast (i.e. more than 0.5% probability or more than 1 in 200).
Zone B Moderate probability of flooding.	This zone defines areas with a moderate risk of flooding from rivers (i.e. 0.1% to 1% probability or between 1 in 100 and 1 in 1000) and the coast (i.e. 0.1% to 0.5% probability or between 1 in 200 and 1 in 1000).
Zone C Low probability of flooding.	This zone defines areas with a low risk of flooding from rivers and the coast (i.e. less than 0.1% probability or less than 1 in 1000).

3.4 Objectives and Principles of the Planning Guidelines

The 'Planning System and Flood Risk Management' describes good flood risk practice in planning and development management. Planning authorities are directed to have regard to the Guidelines in the preparation of Development Plans and Local Area Plans, and for development control purposes.

The objective of the 'Planning System and Flood Risk Management' is to integrate flood risk management into the planning process, thereby assisting in the delivery of sustainable development. For this to be achieved, flood risk must be assessed as early as possible in the planning process. Paragraph 1.6 of the Guidelines states that the core objectives are to:

- "*avoid inappropriate development in areas at risk of flooding;*
- *avoid new developments increasing flood risk elsewhere, including that which may arise from surface run-off;*
- *ensure effective management of residual risks for development permitted in floodplains;*
- *avoid unnecessary restriction of national, regional or local economic and social growth;*
- *improve the understanding of flood risk among relevant stakeholders; and*

- *ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management".*

The Guidelines aim to facilitate '*the transparent consideration of flood risk at all levels of the planning process, ensuring a consistency of approach throughout the country.*' SFRAs therefore become a key evidence base in meeting these objectives.

The 'Planning System and Flood Risk Management' works on several key principles, including:

- Adopting a staged and hierarchical approach to the assessment of flood risk;
- Adopting a sequential approach to the management of flood risk, based on the frequency of flooding (identified through Flood Zones) and the vulnerability of the proposed land use.

3.5 The Sequential Approach and Justification Test

Each stage of the FRA process aims to adopt a sequential approach to management of flood risk in the planning process.

Where possible, development in areas identified as being at flood risk should be avoided; this may necessitate de-zoning lands within the plan boundary. If de-zoning is not possible, then rezoning from a higher vulnerability land use, such as residential, to a less vulnerable use, such as open space may be required.

Figure 3-2 Sequential Approach Principles in Flood Risk Management

Source: The Planning System and Flood Risk Management (Figure 3.1)

Where rezoning is not possible, exceptions to the development restrictions are provided for through the Justification Test. Many towns and cities have central areas that are affected by flood risk and have been targeted for growth. To allow the sustainable and compact development of these urban centres, development in areas of flood risk may be considered necessary. For development in such areas to be allowed, the Justification Test must be passed.

The Justification Test has been designed to rigorously asses the appropriateness, or otherwise, of such developments. The test is comprised of two processes; the Plan-

making Justification Test, and the Development Management Justification Test. The latter is used at the planning application stage where it is intended to develop land that is at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be considered inappropriate for that land.

Table 3-3 shows which types of development, based on vulnerability to flood risk, are appropriate land uses for each of the Flood Zones. The aim of the SFRA is to guide development zonings to those which are 'appropriate' and thereby avoid the need to apply the Justification Test.

Table 3-3 Matrix of Vulnerability versus Flood Zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (Including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Source: Table 3.2 of The Planning System and Flood Risk Management

3.6 Scales and Stages of Flood Risk Assessment

Within the hierarchy of regional, strategic and site-specific flood-risk assessments, a tiered approach ensures that the level of information is appropriate to the scale and nature of the flood-risk issues and the location and type of development proposed, avoiding expensive flood modelling and development of mitigation measures where it is not necessary. The stages and scales of flood risk assessment comprise:

- **Regional Flood Risk Appraisal (RFRA)** – a broad overview of flood risk issues across a region to influence spatial allocations for growth in housing and employment as well as to identify where flood risk management measures may be required at a regional level to support the proposed growth. This should be based on readily derivable information and undertaken to inform the Regional Planning Guidelines.
- **Strategic Flood Risk Assessment (SFRA)** – an assessment of all types of flood risk informing land use planning decisions. This will enable the Planning Authority to allocate appropriate sites for development, whilst identifying opportunities for reducing flood risk. This SFRA will revisit and develop the flood risk identification undertaken in the RFRA, and give consideration to a range of potential sources of flooding. An initial flood risk assessment, based on the identification of Flood Zones, will also be carried out for those areas which will be zoned for development. Where the initial flood risk assessment highlights the potential for a significant level of flood risk, or there is conflict with the proposed vulnerability of development, then a site specific FRA will be recommended, which will necessitate a detailed flood risk assessment.
- **Site Specific Flood Risk Assessment (FRA)** – site or project specific flood risk assessment to consider all types of flood risk associated with the site and propose

appropriate site management and mitigation measures to reduce flood risk to and from the site to an acceptable level. If the previous tiers of study have been undertaken to appropriate levels of detail, it is highly likely that the site specific FRA will require detailed channel and site survey, and hydraulic modelling.

4 Data Collection

4.1 Overview

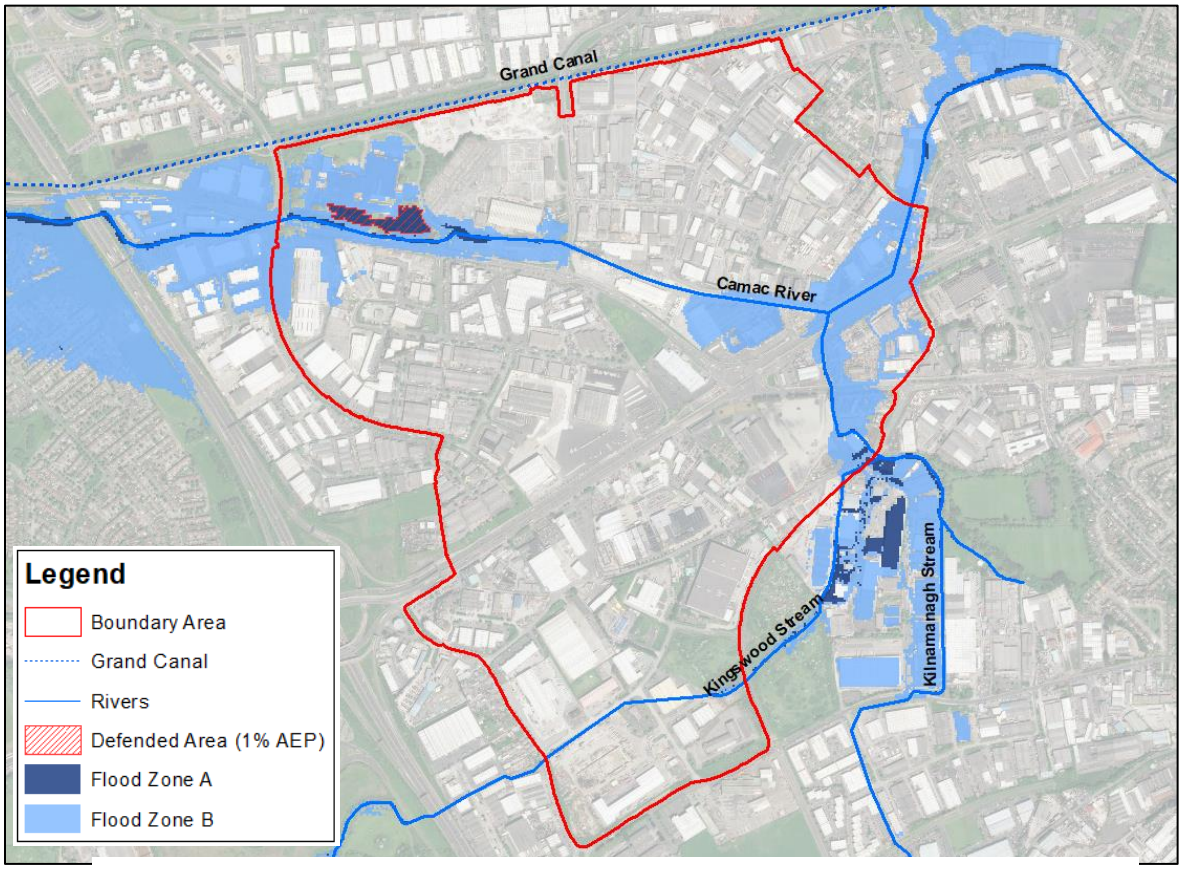
There are several sources of flood data available for the study area. The following table lists the core datasets used to compile the flood map for the study area and gives an assessment of the data quality and the confidence in its accuracy.

Table 4-1 Flood Data Used to Compile Flood Zone Mapping

Description	Coverage	Robustness	Comment on usefulness
Eastern CFRAM Flood Mapping	Covers the River Camac, Kingswood Stream, Kilnamanagh Stream and Walkinstown Stream	Moderate/ High HPW (High Priority Watercourse) status.	HPW status CFRAM model. Calibration carried out under CFRAM, good agreement with historic data.
OPW PFRA flood extent maps, as verified by CFRAM FRR	Covers CFRAM watercourses	Low	Superseded by the CFRAM outlines, not used.
Historical Flood Records	Spot coverage of study area	Moderate	Highly useful oversight of historic flooding issues provided by CFRAM reporting.

The final Flood Zone mapping consists of Eastern CFRAM mapping, it is the best available data source and covers all of the watercourse in the study area, with the exception of the Grand Canal, which is not a fluvial flood source. There has also been a thorough review of historic flood records. Figure 4-1 presents an overview of the Flood Zones and watercourses. Each of the sources of flood information is discussed in more detail below.

Figure 4-1 Flood Zone mapping



World Imagery - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.2 National PFRA Study Fluvial Flood Outlines

The Preliminary Flood Risk Assessment (PFRA) is a national screening exercise that was undertaken by the OPW to identify areas at potential flood risk. The PFRA was a requirement of the EU Floods Directive and the publication of this work informed the more detailed assessment that is being undertaken as part of the Catchment Flood Risk Assessment and Management (CFRAM) studies. The PFRA study considered flooding from several sources; fluvial, tidal, pluvial and groundwater and resulted in production of a suite of broadscale flood maps.

This methodology did not consider defences, channel structures or channel works. Potential sources of error in the mapping include local errors in the DTM or changes to the watercourse flow route due to an error in mapping or new development. In the study area the PFRA mapping covers the River Camac and Kingswood Stream, but the data is much less accurate and is superseded by the Eastern CFRAM mapping.

4.3 Final Flood Zone Outlines – Description of Methodology and Management Plan for the Eastern CFRAM

The Eastern CFRAM flood mapping forms the best available data on flooding and this section introduces the methodology and the findings of the Flood Risk Management Plan for the Naas Road / Ballymount area.

Following on from the PFRA study, the OPW commenced appointment of consultants to carry out a more detailed flood risk assessment for key flood risk areas. This work is being

undertaken under the national CFRAM programme across seven river basin districts in Ireland.

The study area falls within the Eastern CFRAM Study area and was subject to full hydraulic analysis under Eastern CFRAM. This included a detailed 1D-2D Infoworks ICM hydraulic model of the Camac River, Kingswood Stream, Kilnamanagh Stream and Walkinstown Stream. The CFRAM mapping represents a significant improvement compared to the accuracy provided by the PFRA mapping and the CFRAM mapping, more detailed description continues below.

4.3.1 Modelling Methodology

A decision was made to model the Camac catchment using Infoworks ICM, which is a modelling package that allows integration of the analysis of surface water and fluvial risks to be incorporated.

In many urban areas there is a high level of interdependence with these two sources of flooding as the surface water network is dense and drains into watercourses that have been heavily modified and culverted. This is the case with the Camac system inside the M50. Using this representation, the fluvial watercourse system is integrated with the surface water drainage network and surcharging surface water manholes can spill to the 2D model domain and re-enter the pipe network via non-flooding manholes and gullies.

It is important to note that the Eastern CFRAM used Infoworks ICM on the Camac, but it did not fully incorporate the surface water drainage system (using legacy drainage network models in Infoworks CS plus pipe and manhole data from the GDSDS study). This was achieved for the Poddle but not the Camac. It therefore presents a more limited representation of the surface water drainage system. It does however offer the benefit of applying rainfall data directly to the model nodes, with a hydrograph inflow applied at the most upstream node of the model reach to account for flow generated in the upper part of the catchment. It should therefore partially incorporate pluvial risk within the system.

4.3.2 Model Results & Calibration

Within the study area there is a significant amount of flooding predicted from the Camac along the Nangor Road in the vicinity of the Diageo factory. Further downstream there is significant flooding around the confluence of the Camac and Kingswood Stream at the Naas Road. The majority of flooding is at the 0.1% AEP which indicates that the probability of flooding is moderate. The Diageo factory is the only location within the study area that includes flood extent from the 1% AEP, indicating high probability of flooding, however the factory has installed flood defences that offer protection to the 1% AEP event.

In many cases the predicted flooding has been verified by a significant flood event which occurred in October 2011. Comments made on the public consultation/stakeholders' workshops at the draft mapping stage further supported model calibration and the understanding of flood mechanisms on the Camac system.

The Eastern CFRAM hydraulics report (HA09 Hydraulics Report, IBE0600Rp0027, F06 Final August 2017) states that the model is considered well calibrated given that an event of 1-2%AEP was experienced and relatively well documented in October 2011 and supplemented by information on other fluvial events recorded since the 1980s. One gauging station, located within the modelled extents, was used during both the

hydrological analysis and hydraulic model calibration. A good correlation was achieved between the modelled stage discharge relationship and the spot gaugings at the gauging station, however JBA would note that this is still only a single low flow gauging station with which to calibrate the hydrological analysis.

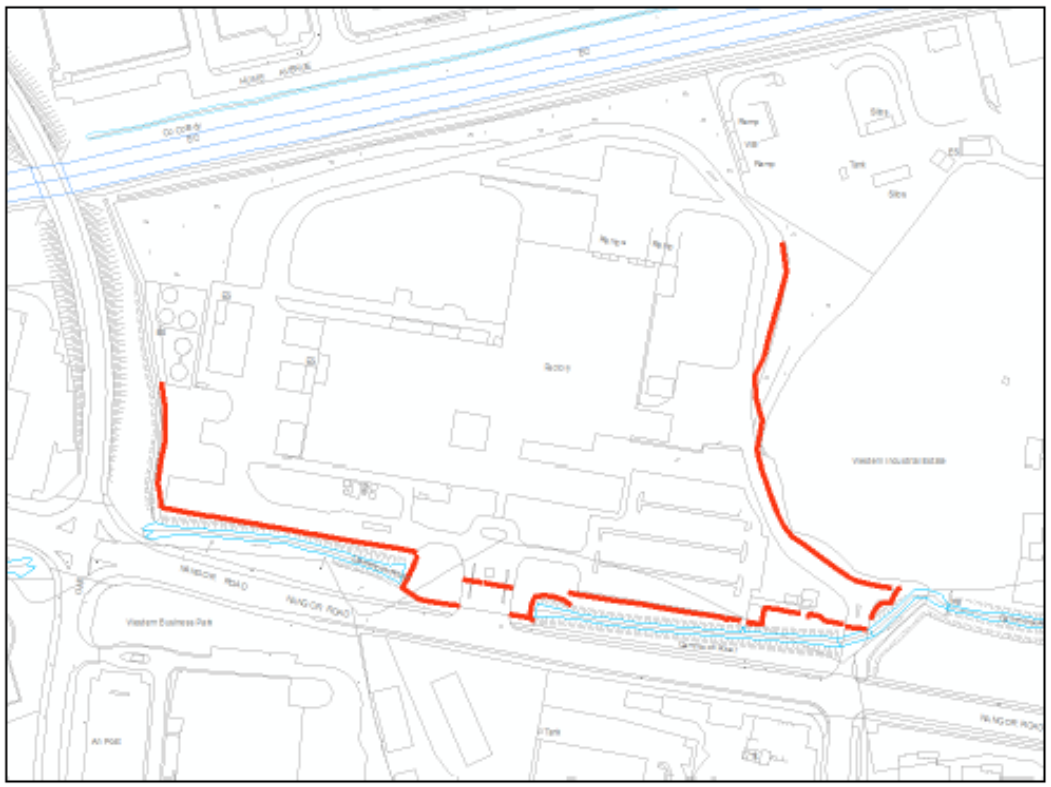
A sensitivity analysis has been undertaken to understand the significance of design assumptions and model parameters used in the analysis. The sensitivity tests indicated that the model is relatively sensitive to changes in model parameters and input data. This indicates a potential vulnerability to climate change impacts – discussed further in Section 4.7.

It is also noted by the hydraulics report that some areas in the lower reaches of the modelled catchment are known to be susceptible to both fluvial and pluvial flooding leading to some ambiguity with the source of flooding in historic recorded flood extents.

4.3.3 Existing Flood Defences

One set of existing flood defences which have been predicted to be effective to above the 1% AEP event is located within the study boundary at the Diageo Factory (see Figure 4-2 below, defended area is also represented within Figure 4-1). Just outside the study boundary a defence wall deemed ineffective during a 1% AEP event is in place on the Robinhood Industrial Estate.

Figure 4-2 Diageo Flood Defence Infill Survey (Figure 4.13.6 HA09 Hydraulics Report)



4.3.4 The Flood Risk Management Plan

For the Camac River, there was no viable scheme recommended as part of the CFRAM process. However, the Camac Flood Protection Project was initiated as part of the CFRAM process following major fluvial flooding in 1986 and 2011. It is currently at pre-feasibility stage following no apparent viable overall scheme emanating from the CFRAM process.

The next step is to appoint a service provider in 2018/19 to review the CFRAM outputs and see if local options may be possible to reduce flood risk for approximately 570 properties estimated to be at flood risk in a 100-Year flood (1% Annual Exceedance Probability).

4.4 Historic Flood Review

Records of past flooding are useful for looking at the sources, seasonality, frequency and intensity of flooding. Historical records are mostly anecdotal and incomplete but are useful for providing background information.

The pertinent flood risk history from consultation and OPW sources are summarised in Figure 4-3 and Table 4-2below. A total of five points are identified as having previous flooding history, three of which are directly within the study area.

Figure 4-3 Historic Flood Mapping; Spatial Representation

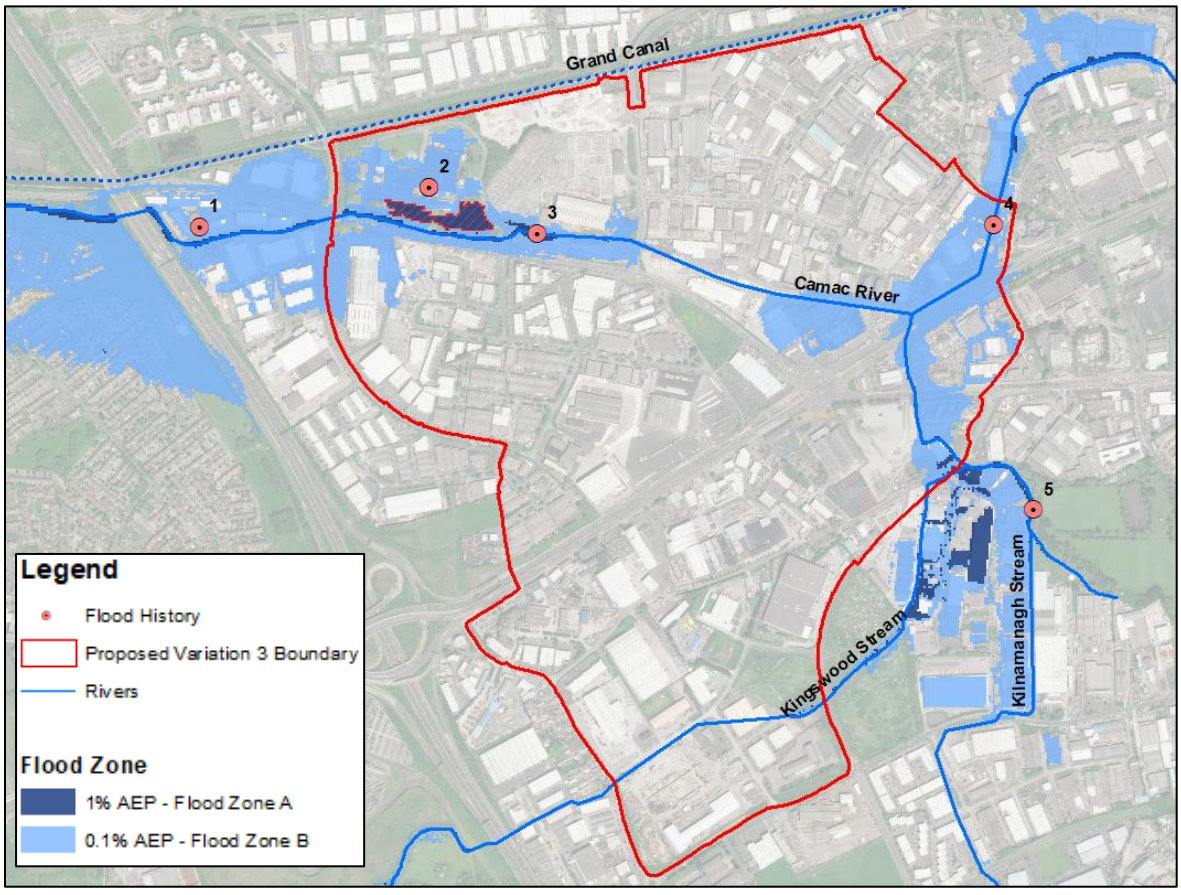


Table 4-2 Historic Flooding Information - quoted from Eastern CFRAM HA09 Inception Report and Flood Maps.ie

Date of Flood	Description
n/a - Recurring	Recurring flooding is noted at Flood Point 4 and 5 (Figure 4-3). This is on old Naas Road (culvert capacity/blockage issue) and Robin Hood Business Park. These locations may be particularly susceptible to either culvert size or blockage impacts.
October 2011	90mm of rain in 6 hours. Circa 2% AEP fluvial flood event and significant flooding across greater Dublin. Camac flooding impacted the area around the Diageo Factory and the Robin Hood Industrial Estate (Flood Point 2 & 5 in Figure 4-3). Riverview Business Estate (Flood Point 1 in Figure 4-3) was also impacted.
November 2000	Limited information available from EPA report noting 'topping' of a water level recorder due to backup of water from a trash screen located downstream (Flood Point 3 in Figure 4-3). Important to note impact of blockage debris within the system.
June 1993	Extreme rainfall event (24hr rainfall AEP of 0.4%). Camac flooding to Old Nangor Road.
August 1986	Hurricane Charlie – high rainfall (100mm over 24 hours at Saggart equating to a 1% AEP rainfall event) and gale force winds. 30 properties flooded within the Camac catchment – location if properties not clarified.
November 1965	Three days of torrential rain caused flooding from the Camac, Tolka and Dodder. Locations unconfirmed.
December 1954	Torrential rain caused fluvial flooding on Tolka, Wad and Camac. Fluvial AEP estimated at 1.1%. Locations not confirmed.

4.5 Sources of Flooding

A review of the historical event data and predictive flood information has highlighted several sources of potential flood risk to the area. These are discussed in the following sections.

4.5.1 Fluvial Flooding

Fluvial flooding is well represented by the Eastern CFRAM flood mapping and this indicates that in an unblocked state the system can largely manage flows from the 1% AEP event. Under increased flow then the system fails to contain flooding at the 0.1% AEP event which results in a much greater flood extent.

However, the above scenario is only partly representative of the risk. There is significant historic evidence that suggests recurring flooding is happening and that the events that are causing flooding are related to additional contributory factors such as structure blockage, management measures and a combination with pluvial flood events. These issues are discussed separately under Sections 4.5.2 and 4.6.2.

The implication of the above finding is that the Camac system through the subject area is sensitive to increases in flow (climate change) and debris/blockage. Given that the CFRAM Infoworks ICM model did not incorporate the surface water drainage system there is room for expanding the hydraulic model, results confirm that some caution should be applied to the results.

Most critically, the Camac Flood Protection Project represents a clear opportunity to improve the hydraulic model representation of the Camac system, incorporate surface water drainage and present a protection scheme that can manage flood risk and allow regeneration of the Naas Road / Ballymount area in a manner that is sustainable, in line with the potential masterplan/LAP and that satisfies the Planning System and Flood Risk Management Guidelines.

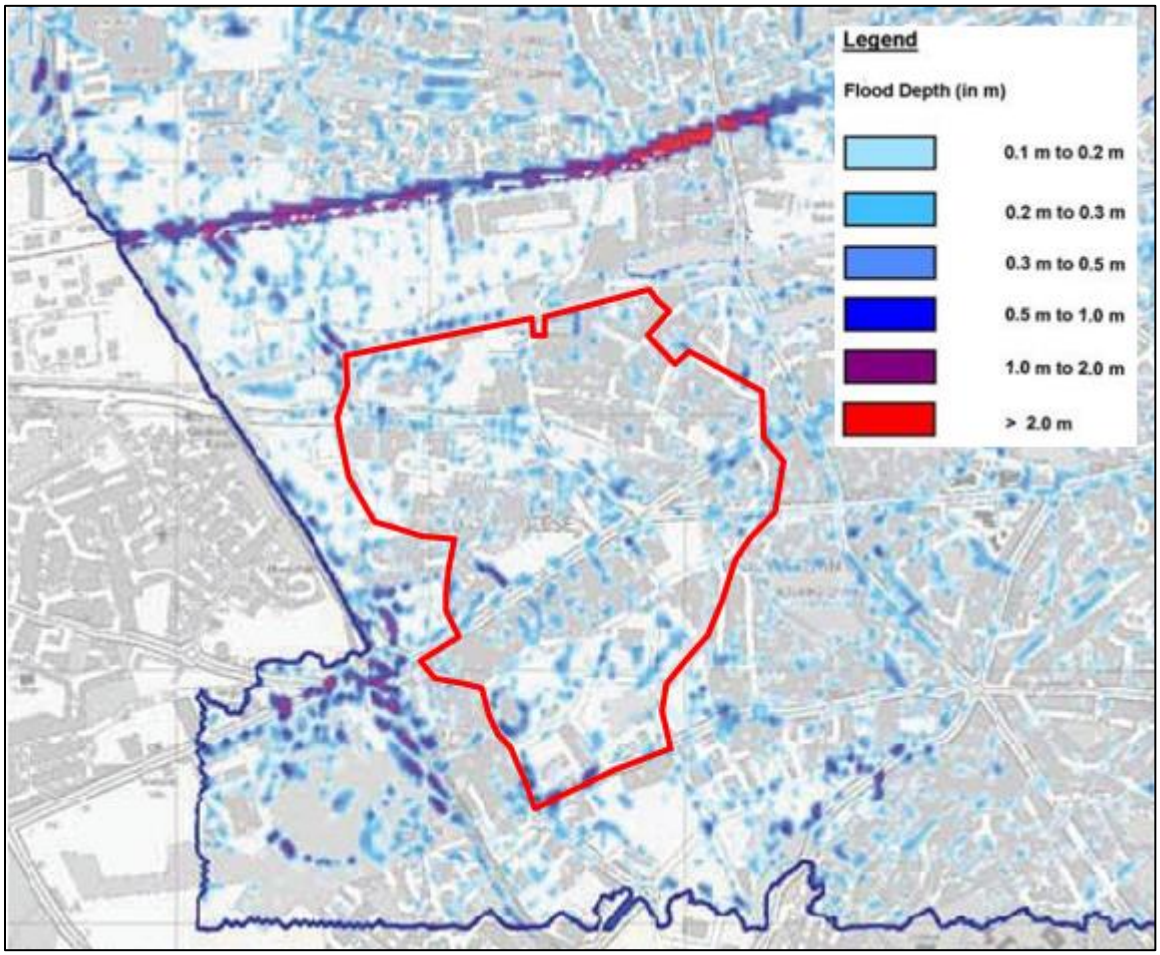
4.5.2 Surface Water / Pluvial Flooding

Flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. A report was undertaken as part of the EU Interreg IVB FloodResilienCity Project to identify pluvial flooding hazards across Dublin City. The EU Interreg programme is a collaboration between EU partner authorities and organisations of which Dublin City is a member. The aim of the programme is to share knowledge and experience at a European level. Regarding the Dublin work package, the aim of the FloodResilienCity Project is to assist in the development of a pluvial flood risk management strategy for Dublin.

As part of the project, a city wide pluvial model was developed to provide flood hazard mapping for Dublin City. The hydraulic model was based on the 1% AEP (180mm) return rainfall event. The flood map covering the site is shown in Figure 4-4, it indicates sporadic flooding within the study area and it is noted that pluvial flooding was a key concern resulting from the public consultation exercise on the Eastern CFRAM.

A Surface Water Management Plan (SWMP) will be required that provides a more detailed analysis of the network and establishes clear policies on the management of surface water to ensure the risk will be adequately managed. The regeneration of the study area represents an excellent opportunity to open up the watercourses and manage surface water runoff in a more sustainable manner.

Figure 4-4 Dublin FloodResilienCity Pluvial Flood Maps



4.5.3 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from the subsurface and is particularly common in karst landscapes. This source of flooding can persist over several weeks and poses a significant but localised issue that has attracted an increasing amount of public concern in recent years. In most cases groundwater flooding cannot be easily managed, or lasting solutions engineered.

The draft PFRA groundwater flood maps[2], which entailed an evidence-based approach and considered the hydro-geological environment, such as the presence of turloughs, shows no risk within the Naas Road / Ballymount study area.

4.6 Residual Risk

4.6.1 Canal Overtopping/Breach

The Grand Canal provides much of the northern boundary to the study area. The canal is situated at grade for the most part but is on a slightly raised embankment (circa 2m) in the north east corner. The likelihood and extent of breach of this raised canal has been considered, the embankment appears to be in good condition and the likelihood of overtopping or breach is low given the wide top of bank/tow path area and as far as JBA is aware there is no further vulnerability due to existing overflow sluices/drains into the Camac at this point.

Regular monitoring by Waterways Ireland of the embankment is recommended to ensure that this risk is managed and at this stage it is not recommended that any further breach modelling analysis is required, but it may be something that could be incorporated into further masterplanning or LAP assessments.

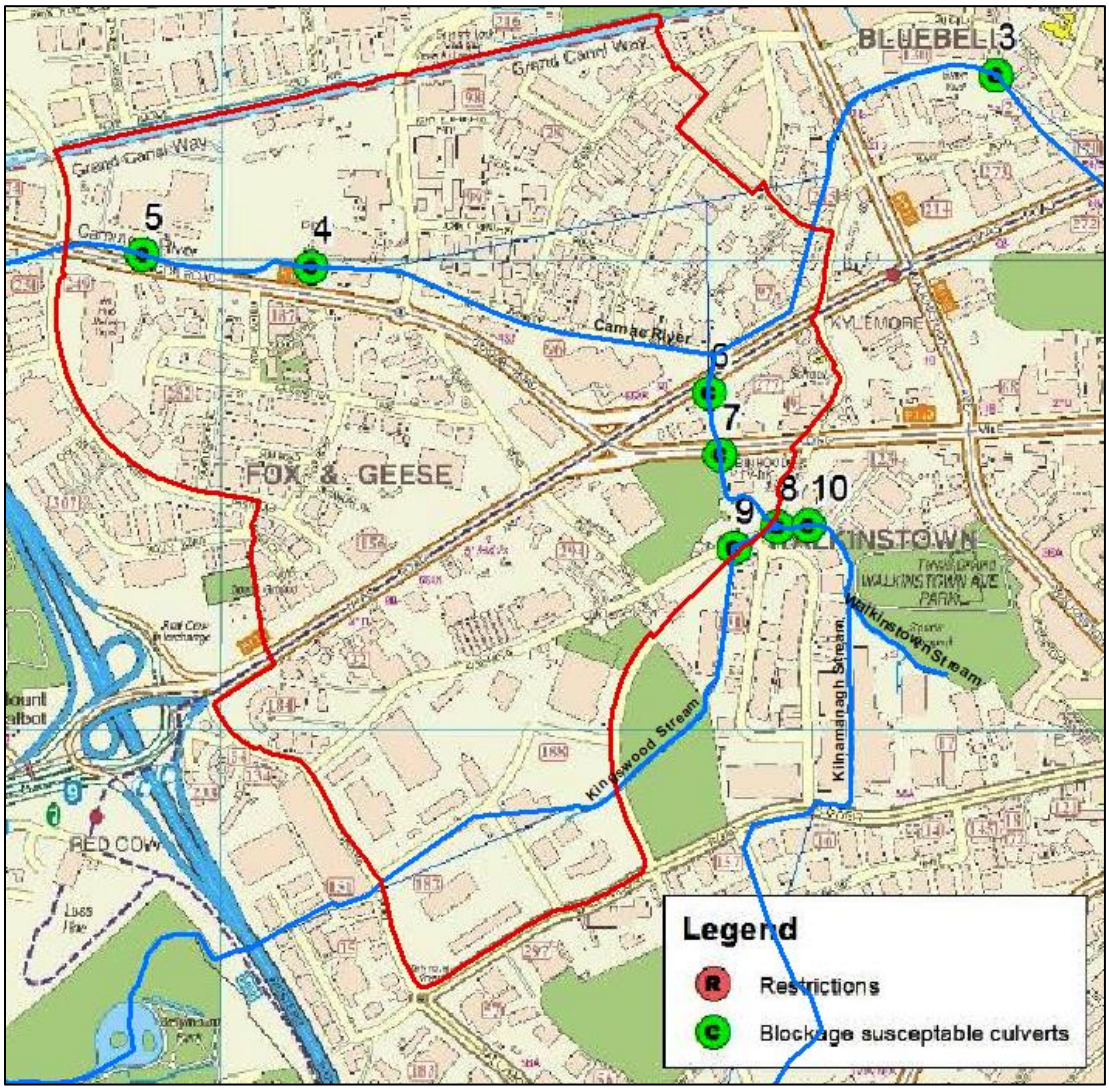
4.6.2 Culvert Blockage & Channel Maintenance

Following the clear evidence that suggests a causal link to historic flooding from structure blockage and public demand under the Eastern CFRAM Public Consultation an additional culvert blockage analysis and maintenance review was conducted.

The additional work identifies culverts at risk of blocking and those causing restrictions to the in channel flow. The maintenance review of the River Camac identified any maintenance measures required.

Further detail on the methodology are presented under Section 8 of the Camac Options Report (IBE0600Rp0031_Camac Options Report_F02, May 2014). The results are presented in the figure below and indicate seven culverts susceptible to blockage within or immediately adjacent to the study boundary. Specific recommendations for each culvert are provided in Appendix A and all culverts were promoted for further assessment and mitigation design.

Figure 4-5 Culverts at Risk of Blockage (Figure 8.2 from Camac Options Report)



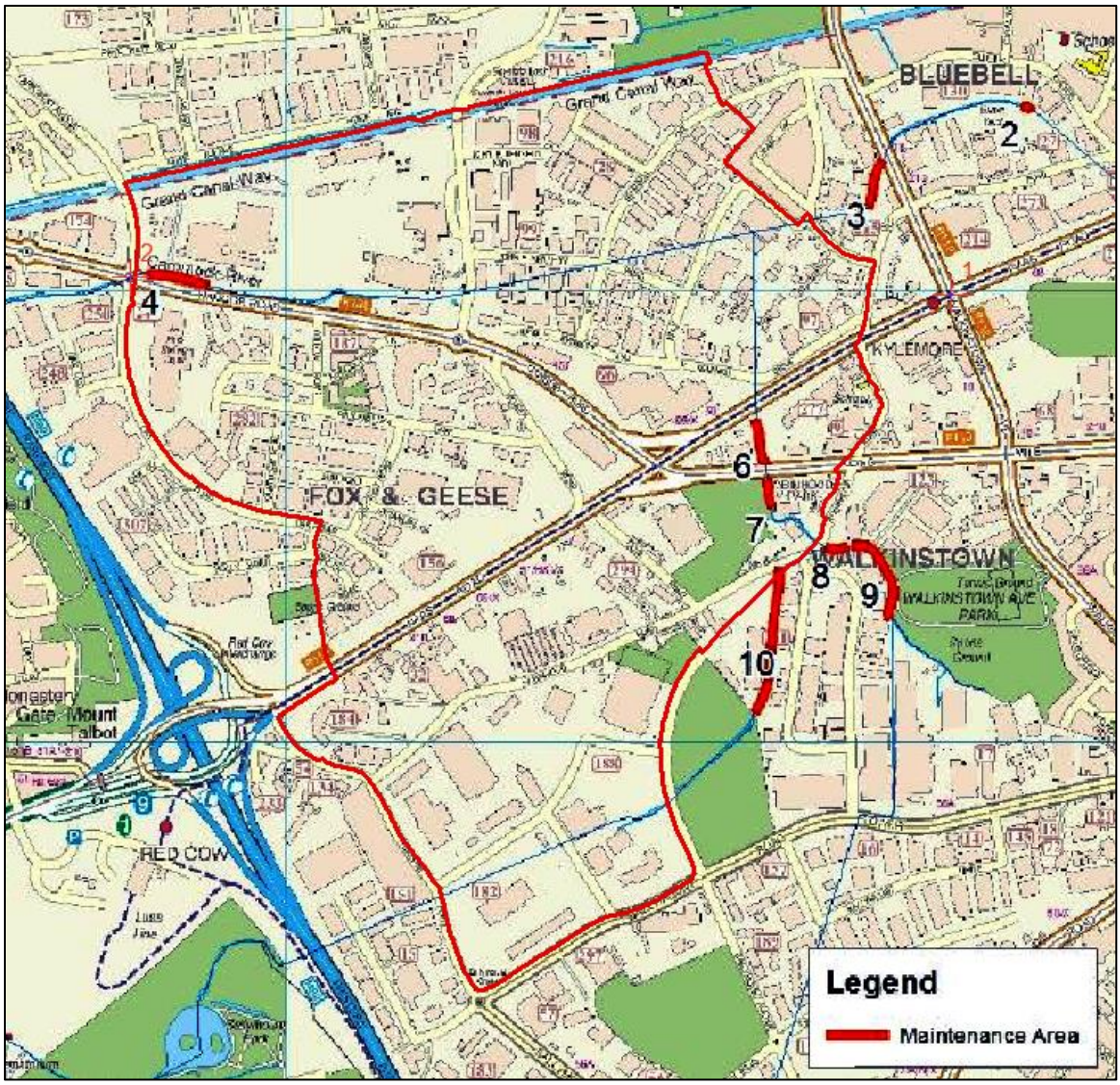
Rubbish tipping and debris blocking on stretches of the Camac and culverts is a recurring problem.

According to the Camac Options Report Dublin City Council and South Dublin County Council both proactively maintain the River Camac and have provided additional maintenance measures since the October 2011 flood. These measures include debris removal and vegetation control which help to improve the free flow of water.

The Camac Options Report identified seven areas (3, 4, 6-10) within or immediately adjacent to the study area that have been identified as requiring vegetation and debris control and monitoring (see Figure 4-6 below). The locations are all near to the culverts identified as being at risk of blockage in Figure 4-5.

The recommendations mainly consist of measures already installed by the Local Authorities but for the purposes of the SFRA indicate the high level of sensitivity of the system and the ongoing requirement to manage this residual risk though policy and mitigation at a plan making level.

Figure 4-6 Maintenance Areas (Figure 8.4 from Camac Options Report)



4.7 Climate Change

The Planning System and Flood Risk Management guidelines recommends that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects.

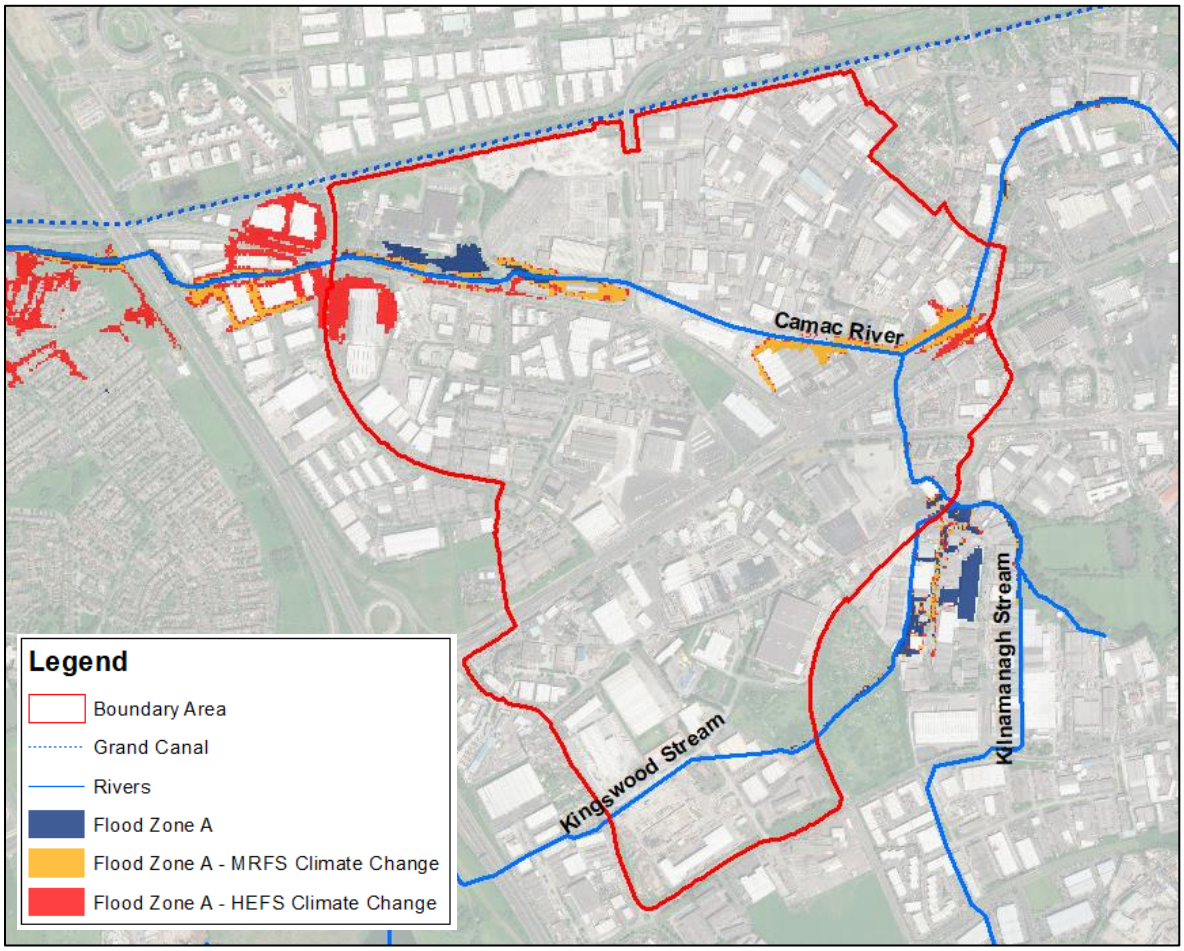
Specific advice on the expected impacts of climate change and the allowances to be provided for future flood risk management in Ireland is given in the OPW draft guidance. Two climate change scenarios are considered. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). 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 3 4 below.

Table 4-3 Allowances for Future Scenarios (100 Year Time Horizon)

Criteria	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) accordingly; 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		

Sensitivity testing under the Eastern CFRAM ran the 10%, 1%, & 0.1% AEP event under the MRFS scenario and found that the system is sensitive to the impacts of climate change at the 0.1% AEP event. Increases at the 1% AEP are less pronounced. A comparison between current Flood Zone A and future MRFS and HEFS scenarios can be seen below in Figure 4-7.

Figure 4-7 Comparison between 1% AEP and MRFS 1% AEP event (from Figure 4.13.38 CFRAM HA09 Hydraulics Report)



5 Flood Risk Management Plan

The Planning Guidelines recommend a sequential approach to spatial planning, promoting avoidance rather than justification and subsequent mitigation of risk. The implementation of the Planning Guidelines within the study area will be achieved through the consideration, revision and addition to the policies and objectives from the South Dublin County Council Development Plan 2016-2022, as reproduced in Section 2.4 of this document.

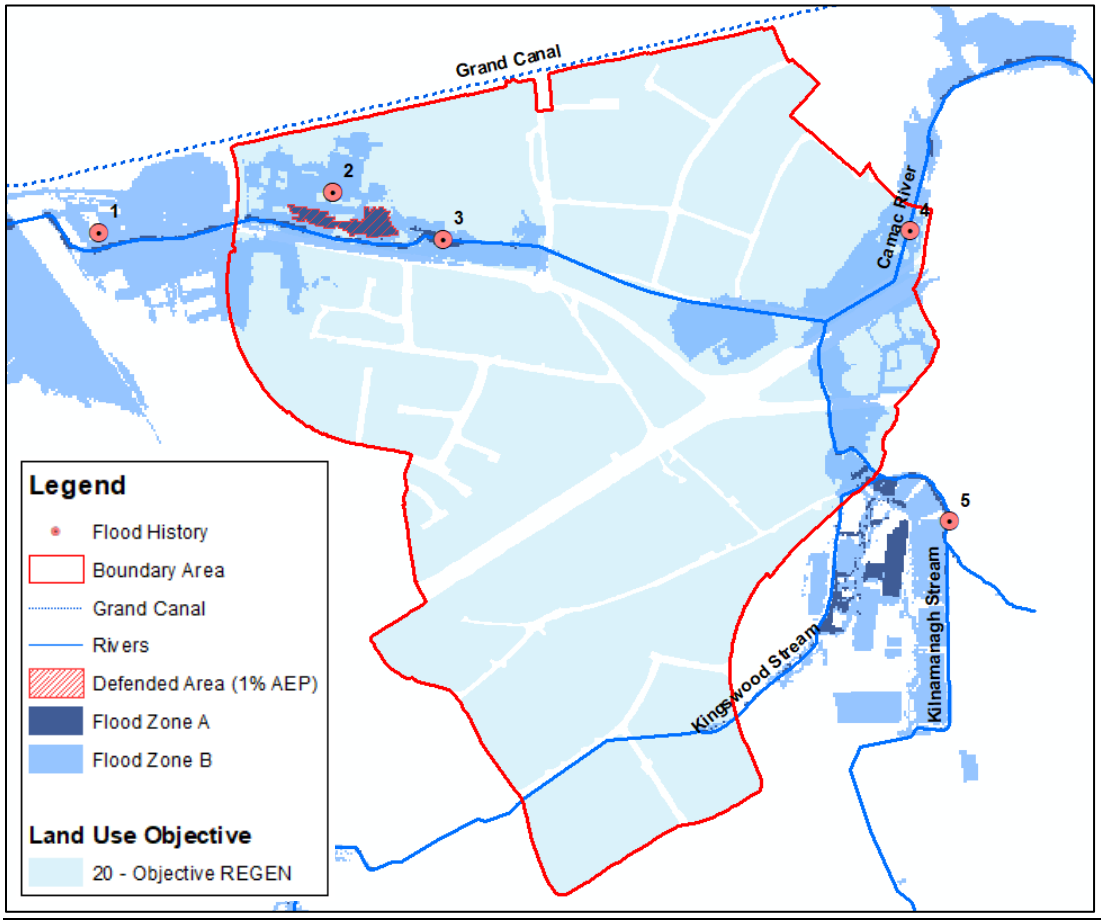
The current recommendations are on the basis that at this point it is only the general requirements for the future management of flood risk in the Naas Road / Ballymount regeneration lands that is being considered.

5.1 Strategic Overview

Given the general aim of transforming this brownfield area of national significance into a sustainable, vibrant, mixed use urban quarter there is a clear opportunity to integrate the Guidelines at an early stage in the statutory process and integrate green infrastructure, surface water management and fluvial flood risk management into the masterplanning process.

The vulnerability of the REGEN land use in itself is split between highly vulnerable and less vulnerable as it incorporates uses that range from residential, education, health care, residential institutions to industry, technology-based enterprise and recreational facilities. An initial overlay of proposed zoning and the proposed REGEN land use objective is presented below in Figure 5-1.

Figure 5-1: Proposed Land Uses and Flood Zones



Within the proposed zoning type there is a clear overlap with Flood Zone A and B. It will be important to carefully consider the mitigation and location of vulnerable uses within the finalised masterplan and provide a high level of detail regarding mitigation and design strategy, but this must be reliant on a revised hydraulic modelling and options study that will be progressed as part of the forthcoming flood protection project. The Proposed Variation No.3 to amend the zoning from EE to REGEN and require the preparation of a masterplan for the regeneration of the area provides a significant opportunity for the future management of flood risk in the area.

5.2 Recommended Objectives for the Management of Flood Risk

The overriding priority for the management of flood risk and future development of flood risk in the study area is that the Camac Flood Protection Project is commissioned and run in close collaboration with the next phases of planning for the regeneration of the subject area (Masterplan).

This review has highlighted several key risk factors that must be studied in further detail and these principally include;

- Integration of fluvial flood risk models with surface water drainage network modelling;
- A surface water management strategy;
- Management of structure blockage / channel maintenance and;
- Potential mitigation measures for the impacts of future climate change.

Table 5-1 Objectives

No.	Objective
1	Promote and support the Camac Flood Protection Plan, integrating the modelling and analysis required for the plan as part of the masterplanning phase.
2	Undertake further detailed hydraulic modelling that integrates the surface water drainage network and allows the development of fluvial and surface water management measures for the regeneration lands that includes the consideration of residual risk and climate change.
3	Manage the future development of the study area in accordance with the core principles of the Planning System and Flood Risk Management Guidelines.
4	Ensure that surface water management is integrated into the regeneration process through the development of a Surface Water Strategy that is based on current best practise guidance (GDSDS and CIRIA), see Section 5.3.
5	Develop specific guidance for the management of fluvial and surface water risk at Development Management Stage as part of the masterplanning for the Naas Road / Ballymount area.

5.3 Management of Surface Water

The outline requirements for the management of surface water within the study area should be such that:

- There is no increased risk of flooding downstream;
- There is no increased risk of flooding to adjacent properties;
- There is minimal risk to proposed development within the subject site;
- It adheres to the requirements of the Greater Dublin Strategic Drainage Strategy (GDSDS).

In addition, the requirements of the Surface Water Strategy for the subject lands shall be complied with in order to enable an orderly and sustainable development of both the individual plots and the public realm areas, namely the public roads and associated green open spaces and/or parks.

The SWS should outline a strategy to manage surface water in a sustainable way, ensuring there is no unacceptable residual risk to each site, ensuring no increase in flood risk upstream or downstream from each development, and potentially reduce the amount of surface water entering the piped sewer system. The surface water will be discharged into the Camac watercourses and allowable discharge rates should be advised based on a detailed analysis of the integrated hydraulic model.

There are significant flooding issues along the Camac system. As assessed under the Eastern CFRAM Study, the focus of a potential strategy should be to manage surface water in a sustainable way, ensuring there is no unacceptable residual risk of flooding to each site; resulting in no increased flood risk up or downstream from each development and is a strategy that must be developed in combination with the Camac Flood Protection Project.

The guiding principles for the potential SWS approach are shown in Table 5-2 below. The following stormwater management principles provide a basis for sustainable development of the subject lands in terms of the management and control of stormwater discharge. These should be key considerations when moving into the Stage 2 – Integration of SFRA with masterplanning and SEA processes and preparation of a SWMP.

Table 5-2: SWS Principles

	Principle	Purpose
1	Manage surface runoff at source	Prevention or reduction of surface water flows. The GDSDS states that there should be no discharge to a surface water body or sewer from the first 5-10mm of any rainfall event.
2	Manage water on the surface	The ability to intercept flows and direct them to areas designed to treat, store and discharge flows away from homes, businesses and transportation networks where disruption and flooding can occur.
3	Utilise public space and integrate into the drainage design	SuDS can provide intrinsically attractive features and focal points within the landscape and have added ecological value; by incorporating these features into open public spaces local communities can enjoy a variety of diverse ecological features. This allows developers to capitalise on developable space by not having to provide separate spaces for SuDS and community open spaces. Integrating SuDS features into open public spaces also facilitates easier maintenance access and can help enhance biodiversity.

	Principle	Purpose
4	Effective operation and maintenance	A robust operation and maintenance schedule of SuDS measures should be produced and adhered to, to ensure SuDS measures are operating to their full capacity, and that life cycles can be extended as much as possible. SuDS designs and maintenance schedules should be agreed with those adopting them early in the planning process. It can be beneficial to make maintenance contracts mandatory in advance of SuDS construction. The lifespan of SuDS measures should also be considered in design.
5	Account for climate change and changes in impermeable area	Notwithstanding the requirements of the GDSDS, 20% allowance for climate change will be required for all design, this is in line with OPW guidance.

APPENDIX

A Culvert Blockage Results (from Camac Options Report)

Culvert/Restriction in Flow	Comment	Recommended Action
Area 4 	Course screen attached to footbridge near the Nangor road is in disrepair. Further upstream the staff at the gauge station is damaged	• Carry out an assessment for the need for a course screen. • Upgrade course screen if required/remove screen if required • Replace staff gauge
Area 5 	The culvert at the Diageo Site on the Nangor Road has been identified as at risk of blocking. In places upstream overhanging branches have the potential to restrict flow	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen**. • **Extend head and wing walls** to contain the water.
Area 6 	The culvert on the Robinhood Stream at the Naas Road has been identified as at risk of blocking. The reach of watercourse approaching this culvert is heavily vegetated and full of debris increasing the potential for restricting the flow and blocking the culvert	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen**. • **Extend head and wing walls** to contain the water.
Area 7 	The culvert on the Robinhood Stream at the Long Mile Road has been identified as at risk of blocking. The reach of watercourse approaching this culvert is heavily vegetated and full of debris increasing the potential for restricting the flow and blocking the culvert	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen**. • **Extend head and wing walls** to contain the water.

Culvert/Restriction in Flow	Comment	Recommended Action
C Area 8 	The culvert on the Robinhood Stream at the Robinhood Road has been identified as at risk of blocking. The reach of watercourse approaching this culvert is heavily vegetated and full of debris increasing the potential for restricting the flow and blocking the culvert	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen.** • **Extend head and wing walls** to contain the water.
C Area 9 	The culvert on the Robinhood Stream upstream of the Robinhood Road has been identified as at risk of blocking. The reach of watercourse approaching this culvert is heavily vegetated and full of debris increasing the potential for restricting the flow and blocking the culvert	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen.** • **Extend head and wing walls** to contain the water. • **OR removal of structure**
C Area 10 	The culvert on the Kingstown Stream at the Robinhood Road has been identified as at risk of blocking. The reach of watercourse approaching this culvert is heavily vegetated and full of debris increasing the potential for restricting the flow and blocking the culvert	Carry out an full **economic assessment** to quantify the benefit from managing this flood risk. Consider the following: • **Construct screen.** • **Extend head and wing walls** to contain the water.

APPENDIX

B Flood Zone Map