Comhairle Contae
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South Dublin County Council

Clonburris

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Clonburris Strategic Development Zone (SDZ) Draft Planning Scheme

Strategic Flood Risk Assessment

September 2017

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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 the Clonburris SDZ Draft Planning Scheme.

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

On 15th December 2015, the Government approved the designation of the lands at Clonburris, as a site for the establishment of a Strategic Development Zone (SDZ). Order 2015 (S.I. No. 604 of 2015) established and extended the designated area for the Clonburris SDZ. The Draft Planning Scheme shall be prepared not later than two years after the making of the Order. Under the Designation of Strategic Development Zone: Balgaddy – Clonburris, South Dublin County Order 2015, the lands which are deemed to be of economic and social importance to the state, are:

“designated as a site for the establishment of a strategic development zone in accordance with the provisions of Part IX of the Act for residential development and the provision of schools and other educational facilities, commercial activities, including employment office, hotel, leisure and retail facilities, rail infrastructure, emergency services and the provision of community facilities as referred to in Part III of the First Schedule to the Act, including health and childcare services.”

The Clonburris SDZ Draft Planning Scheme, refer to Figure 1-1, is to be a comprehensive and multi-faceted spatial planning document which will be led by South Dublin County Council, as the Development Agency. The Draft Planning Scheme has been prepared in collaboration with a range of stakeholders including: SDZ landowners, the general public, government agencies and statutory bodies, staff and elected councillors of South Dublin County Council. The making of a Planning Scheme for these lands will revoke the existing Strategic Development Zone Planning Scheme and a Local Area Plan for adjoining lands, both of which were adopted in 2008. The Local Area Plan expired in 2014. The existing SDZ Planning Scheme will remain in place until superseded by the new Planning Scheme for the area.

Figure 1-1:- Clonburris SDZ 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 Clonburris SDZ is the key document for setting out a vision for the development of Clonburris during the plan period.

It is important that the SDZ 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 SDZ, the main requirements of this document are to:

- Produce Flood Mapping.
- Prepare a Stage 2 - Flood Risk Assessment of Clonburris in relation to the location and type of zoning and land-use proposals.
- Prepare a Flood Risk Management Plan 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 on zonings/land use-proposals, 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.

1.4 Report Structure

This study considers the development strategy that will form part of the Clonburris SDZ. The context of flood risk in Clonburris is considered with specific reference to fluvial and

pluvial flooding, with reference also to secondary sources such as, canal groundwater and sewer flooding.

A two stage assessment of flood risk was undertaken, as recommended in the Guidelines, for the area that lies within the development boundary of the strategic development zone. The first stage is to identify flood risk and is based primarily on the findings of the Eastern Catchment Flood Risk Assessment and Management Study (ECFRAM). Historical records and recent events demonstrate that Clonburris has a history of flooding in certain areas. The second stage and the main purpose of this SFRA report is to appraise the adequacy of existing information, to prepare an indicative flood zone map, based on available data, and to highlight potential development areas that require more detailed assessment on a site specific level.

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 Clonburris SDZ Plan.

Finally, requirements for the ongoing monitoring and future review of the SFRA are detailed in Section 6.

1.5 Technical Concepts

1.5.1 Presentation of 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 the table below.

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 Greater Dublin Strategic Drainage Study (GDSDS) also highlights that the issue of climate change is of major importance. The GDSDS Climate Change policy document advises that rainfall event depths should be factored by 10% and that sea level will rise by 400mm or more in the coming century. The GDSDS advises that climate change criteria are applied for the design of drainage systems for new development as follows:

Table 1-2 Climate Change Factors to be Applied to Drainage Design

Climate Change Category	Characteristic
River flows	20% increase in flows for all return periods up to 100 years
Sea Level	400+mm rise (see Climate Change policy document for sea levels as a function of return period)
Rainfall	10% increase in depth (factor all intensities by 1.1)
	Modify time series rainfall in accordance with the GDSDS climate change policy document.

2 Clonburris Study Area

2.1 Introduction

The Clonburris SDZ boundary incorporates the original Clonburris SDZ Planning Scheme 2008 and the Clonburris Local Area Plan 2008 boundaries. The SDZ also includes lands to the west, between Hayden's Lane and the R120. The SDZ site area covers approximately 281 hectares.

The making of a Planning Scheme for these lands will revoke the existing Strategic Development Zone Planning Scheme. The Local Area Plan expired in 2014. The existing SDZ Planning Scheme 2008 will remain in place until superseded by the new Planning Scheme for the area.

Figure 2-1: Clonburris Strategic Development Zone

2.2 Watercourses

2.2.1 Griffeen River

The Griffeen River flows in a northerly direction to the west of the SDZ area boundary. The stream is culverted under the Grand Canal. A short distance downstream the channel splits in two parallel channels, before traversing Hayden's Lane. It continues northwards where it passes under the railway line in two culverts, northern boundary of the SDZ before both branches re-join and it flows northward through Griffeen Park. The Griffeen River is shown in Figure 2-2.

2.2.2 Kilmahuddrick Stream

The Kilmahuddrick Stream, refer Figure 2-2, runs in a north-west direction through the western part of the subject site (west of the Outer Ring Road) and is culverted underneath the railway line and discharges into the Griffeen River. It is primarily fed by the surface

water attenuation pond to the south of the canal, which itself is subject to restricted outflow.

Figure 2-2: Watercourses in SDZ

Field Drainage

The lands consist of c.281 ha which have been modified by man over the course of time. The lands primarily consist of flat grassland, currently used for grazing which is divided into an irregular field pattern by hedgerows and drainage ditches. The hedgerows and associated drainage ditches predate many of the infrastructural elements currently occupying the lands and in some cases form townland and barony boundaries. The lands to the north, south and east of the SDZ are occupied by urban housing.

Figure 2-3: Field Drainage in SDZ

Grand Canal

The Grand Canal provides a significant proportion of the southern boundary to the SDZ (see Figure 2-3). The canal is situated on a raised embankment.

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 section of the canal within the SDZ has 2 no. lock gates, a lock gate cottage and a unique form of overflow system which takes water from the west of the 11th lock, runs parallel to the north of the canal and re-enters the main waterbody to the east of the 9th lock. This system ensures that the canal does not overflow (the canal system and the associated Cappagh Overflow is a self-contained waterbody).

2.3 Environment

The lands primarily consist of flat grassland, currently used for grazing which is divided into an irregular field pattern by hedgerows and drainage ditches. The hedgerows and associated drainage ditches predate many of the infrastructural elements currently occupying the lands and in some cases form townland and barony boundaries.

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, to be read in conjunction with the SDZ Draft Planning Scheme.

2.4 Planning Policy

2.4.1 South Dublin County Development Plan

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). Figure 2-4 below shows an extract in relation to Clonburris in the SFRA for the County Development Plan and these policies have been considered in the development of the SFRA for Clonburris.

Figure 2-4: CDP Recommendations for Clonburris

Undeveloped Existing Zoned Lands At Risk Of Flooding– Highly vulnerable ▪ **Clonburris**	Justification test applied to maintain zone for new residential. Specific flood risk assessment measures will apply to development in these sites.	▪ A stage 1 Flood Risk Identification to identify any flooding or surface water management issues related to the lands ▪ The sequential approach should be applied through site planning and should avoid encroachment onto, or loss of, the flood plain. ▪ 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, and climate change to set finished flood levels where appropriate. The FRAs should ensure development does not block flow paths and does increase flood risk elsewhere. ▪ FRAs should also address surface water management for development, demonstrating consideration of GDSDS policies and incorporation of SuDS e.g. Green Roofs, Rainwater Harvesting and Permeable Surfacing.

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

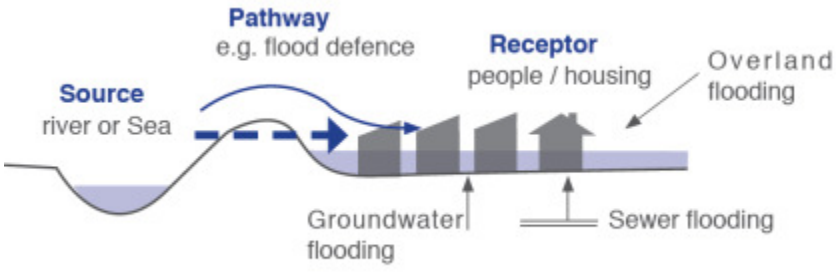


Fig. A1: Sources, pathways and receptors of flooding

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:

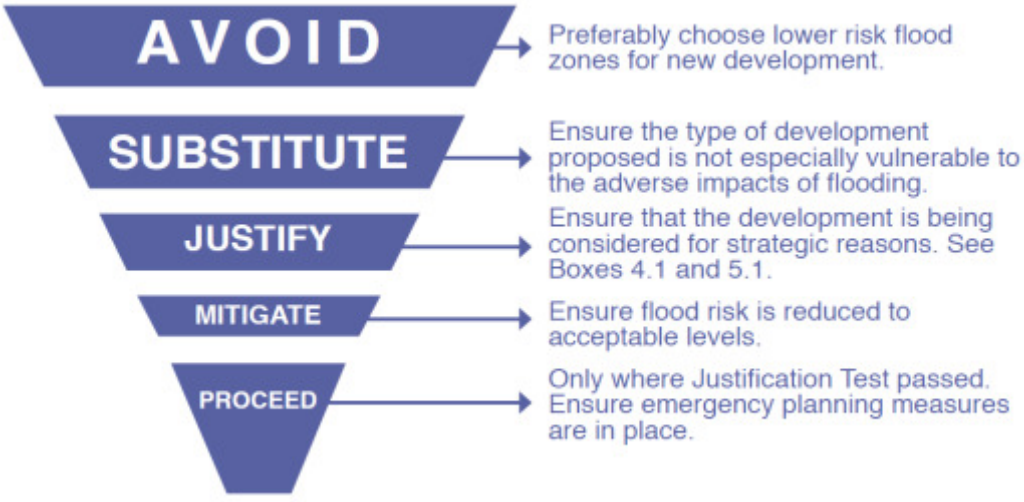
- Adopting a staged and hierarchical approach to the assessment of flood risk;
- Adopting a sequential approach to the management of flood risk, based on the frequency of flooding (identified through Flood Zones) and the vulnerability of the proposed land use.

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 Clonburris area. The following table lists the core datasets used to compile the flood map for the Clonburris SDZ 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 Griffeen	Moderate/ High HPW (high Priority Watercourse) status.	HPW status CFRAM model. Site verified by walkover and consultation with Local Authority.
OPW PFRA flood extent maps, as verified by CFRAM FRR	Covers minor watercourses	Moderate	Superseded by the CFRAM outlines
Historical Flood Records and Consultation with Area Engineer	Spot coverage of whole LAP (Area Engineer specific input).	Moderate	Highly useful oversight of historic flooding issues provided by CFRAM Flood Risk Review.
Walkover Survey	Covers all significant watercourses.	Moderate	Walkover used to validate outlines, estimate new outlines and flow paths at key locations. Essential process in the Flood Zone process.

The Flood Zone mapping represents a combination of the above flood sources. The Eastern CFRAM mapping, has formed the core source of the final Flood Zones for the River Griffeen. All flood mapping has been site verified by a site walkover. There has also been a thorough review of historic flood records. The result is Flood Zone mapping that presents the best available data for the study area.

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

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.

For the preparation of the PFRA fluvial flood maps, flood flow estimates were calculated at nodes every 500m along the entire river network. (The river network is the EPA 'blue-line' network, which, for the most part, matches the rivers mapped at the 1:50,000 scale Discovery Series OS mapping). This flow estimation was based on the OPW Flood Studies Update research programme. An assumption was made that the in-channel flow equates to the mean annual flood and so the out of bank flow for a particular AEP event was determined by deducting the mean annual flood from the flood flow estimate for that probability event.

Using a 5m national digital terrain model (DTM) a cross section was determined at 100m spacings. The Manning's equation, a hydraulic equation for normal flow, was used to calculate a flood level which was then extrapolated across the DTM to determine the flood extent. This exercise was completed by the OPW for all river catchments greater than 1km^2.

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 Clonburris,

the PFRA mapping covers the River Griffeen (although this has been superseded by CFRAM data).

4.3 National CFRAM Programme

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 CFRAM programme commenced with three pilot studies covering the River Lee, Fingal East Meath area and the River Dodder. A further 6 studies are currently underway in the East, South-East, South-West, West, North-West and Neagh-Bann regions.

Clonburris falls within the Eastern CFRAM Study area. The initial Flood Risk Review (FRR) stage of the Eastern CFRAM has been completed and this included a site based review of the PFRA flood outlines for the area, which provided feedback on flood risk and potential for inclusion as a detailed Area of Further Assessment.

The area was subject to the full analysis under Eastern CFRAM. This included a detailed 1D-2D hydraulic model of the Griffeen River. The CFRAM mapping represents a significant improvement compared to the accuracy provided by the PFRA mapping and the CFRAM mapping has been verified by a site walkover and consultation with the local authority.

The CFRAM Flood Risk Management Plan (FRMP) and Preliminary Options Report (POR) confirms that there is no residential or commercial properties at risk in the Clonburris Area, with out of bank flooding affecting agricultural / open space only. The FRMP therefore does not recommend any structural measures to alleviate flood risk for the settlement area.

The Griffeen (in Lucan) and Camac catchments downstream of the settlement area have high risk of flooding to properties and flood alleviation measures have been considered in the CFRAM process. Where viable, flood risk management measures have been outlined in the Flood Risk Management Plan for their respective areas. Three properties are at risk on the Griffeen downstream of the settlement in Lucan, due to King John's Bridge restricting conveyance. A preferred structural measure has been outlined in the draft Flood Risk Management Plan for the area under the Lucan to Chapelizod AFA. However, there is no guarantee if works will be completed and no timescale has been for such works to take place - the works will not impact Clonburris.

For the Camac River, there was no viable scheme recommended as part of the CFRAM process. However, the Camac Flood Protection Project has since been commissioned by the OPW following the major flood events of 1986 and 2011. It is currently at pre-feasibility stage (due to no viable scheme being identified by the CFRAM), with a service provider to be appointed in 2017.

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.

4.4.1 OPW Floodmaps.ie

The OPW hosts a National Flood Hazard Mapping website[1] that makes available information on areas potentially at risk from flooding. This website provides information on historical flood events across the country and formed the basis of the Regional Flood Risk Appraisal.

Information is provided in the form of reports and newspaper articles which generally relate to rare and extreme events. Since the establishment of the hazard mapping website, more records are available which identify more frequent and often recurring events. These tend to include memos and meeting records from local authority area engineers, often relating to road flooding.

4.4.2 Site walkover

A walkover of the site helped to clarify and improve on the general appreciation of flood risk across the settlement. This includes for appropriate screening of the historic and potential flood risk from the smaller watercourses within the settlement boundary.

4.4.3 Summary of Historic Flood Risk

The pertinent flood risk history from both the consultation and OPW floodmaps.ie sources are summarised in Figure 4-2 and Table 4-2 below.

Figure 4-2 Historic Flood Mapping; Spatial Representation

1 www.floodmaps.ie

Table 4-2 Historic Flooding Information - quoted from Eastern CFRAM Inception Report and the consultation with South Dublin County Council

Date of Flood	Description
5th November 2000	Flooding where the Griffeen River passes under the railway line near Hayden's Lane. Flooding caused by a lack of capacity in the culvert under Hayden's Lane causing flooding to the left on the River Griffeen. This floodwater then flowed North through a railway underpass, and onto Hayden's Lane. Since the flood event of November 2000, the channel capacity has been improved, a second culvert has been constructed under Hayden's Lane and the Railway Pass which acted as a flow path for floodwater has been closed off.
5/6 November 2000	Report of recurring flooding at a culvert in Cappaghmore

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

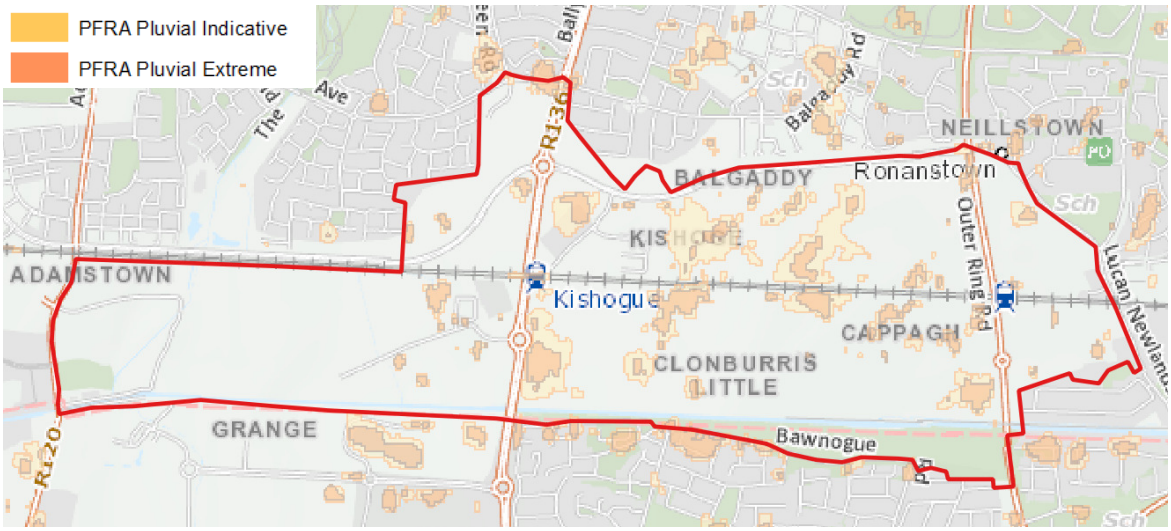
The main source of historic and potential flood risk to development in Clonburris is the River Griffeen which flows northwards through the western side of the settlement. It is joined by the Kilmahuddrick Stream south of the railway line. The River Griffeen is covered in the Eastern CFRAM. The Kilmahuddrick Stream is unmodelled, however, it is fed by the surface drainage attenuation pond from Grange Castle Business Park which is controlled by a hydrobrake and will limit any onward flow. Furthermore, the remaining catchment area will be managed by the SDZ Surface Water Masterplan (SWMP), the risk to flooding is currently low and will be reduced further by the SDZ.

Although there are historic events of flooding for the River Griffeen, listed in Table 4-2, most of these events are limited in consequence and occurred prior to mitigation works. Remaining flooding to the lands is only predicted to occur at the 0.1% AEP event and impacts agricultural lands that have been maintained as open space in the Urban Design Masterplan for the SDZ.

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. The indicative pluvial map from www.myplan.ie shows the OPW PFRA study in Figure 4-3. It has been used to identify development areas at particular risk of surface water and pluvial flooding. Large areas of the eastern side of the settlement have been highlighted as potentially vulnerable to pluvial flooding.

Figure 4-3 PFRA Indicative Pluvial Flood Maps



New development or redevelopment of existing sites adhering to the policies on the management of surface water will ensure the risk will be adequately managed. A Surface Water Strategy (SWS) has been developed for Clonburris that outlines these policies and is discussed further in Section 5.

4.5.3 Groundwater Flooding

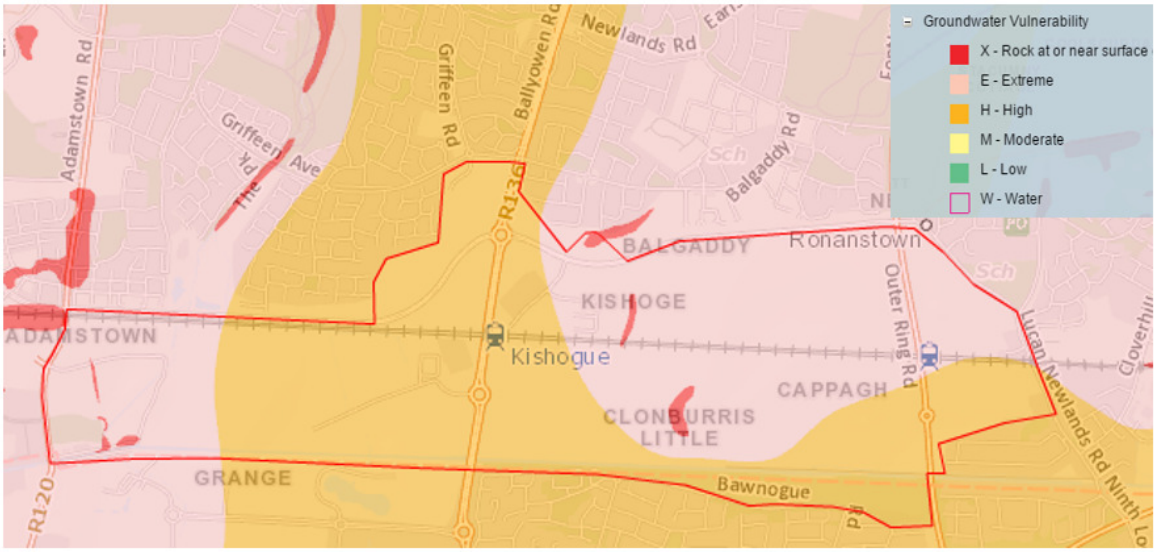
Groundwater flooding is caused by the emergence of water originating from the subsurface, and is particularly common in karst landscapes. This source of flooding can persist over several weeks and poses a significant but localised issue that has attracted an increasing amount of public concern in recent 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 Clonburris Settlement.

The Geological Survey Ireland (GSI) actively maintain and develop national and project based spatial datasets derived from internal programmes relating to Land Mapping, Groundwater, Geotechnical, Landslides, Quaternary, Geological Heritage, Minerals, INFOMAR and Tellus.

An extract from the GSI website relating to groundwater vulnerability is as shown in Figure 4-4. As indicated, the SDZ site is within a catchment where the groundwater vulnerability is considered Extreme and/or High. The impact from any development of the subject site will need to consider the groundwater impacts at detailed design stage.

Figure 4-4: Groundwater Vulnerability Extract Map from GSI Website



4.6 Residual Risk from Canal Breach

The Grand Canal provides much of the southern boundary to the SDZ. The canal is situated on a raised embankment. The likelihood and extent of breach of this raised canal has been considered.

The embankment appeared to be in good condition during the site visits and the likelihood of breach is low.

Failure or breach of an embankment resulting in water from the canal being released resulting in flooding of the surrounding areas was modelled. A 2D TUFLOW model was set up with 5 breach points. Each of the 5 breaches were ran individually, not simultaneously.

A weir equation calculated the flow rates should a breach occur. The volume of water that spilled over the breach was subtracted from the total volume. The head of water is also reduced accordingly. This process continues until the rate of flow reduced to negligible numbers, as well as the head of water, as most of the volume has dissipated. There is a huge volume of spill initially, reducing then as time increases.

Areas proposed for development in the Draft Planning Scheme have mainly been kept on-grade, with only limited infill in some areas to facilitate gravity drainage. The flood depths on proposed development areas have been found to be in the region of 200 to 300mm in a breach scenario with water spilling across the development rather than ponding to large depths. This is an acceptable risk given the probability of breach is low. Given the unlikely scenario of breach the area will remain accessible to emergency services given the depths expected to occur and risk to life is low. There is limited potential to inundate properties with much of the flooding expected to be below a standard threshold level. Regular monitoring by Waterways Ireland of the embankment is recommended to ensure that this risk is managed.

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

4.7.1 Climate Change and Flood Risk Assessment

The Flood Zones are determined based on readily available information and their purpose is to be used as a tool to avoid inappropriate development in areas of flood risk. Where development is proposed within an area of potential flood risk (Flood Zone A or B), a flood risk assessment of appropriate scale will be required and this assessment must consider climate change and associated impacts. Under the National CFRAM programme, the detailed modelling and assessment stage of each study will include for climate change effects, but has not yet been delivered under the draft stage.

Climate change may result in increased flood extents and therefore caution should be taken when zoning lands in transitional areas. As recommended in the Guidelines; Flood Zone B, which represents the 0.1% AEP extent, can be taken as an indication of the extent of the 1% AEP flood event with climate change. In steep valleys, an increase in water level will relate to a very small increase in extent, however in flatter low-lying basins a small increase in water level can result in a significant increase in flood extent.

In the design of flood alleviation measures, climate change should be considered and design levels of structures, such as flood walls or embankments, must be sufficient to cope with the effects of climate change over the lifetime of the structure or where circumstances permit, be capable of adaptation. Further consideration to the potential future impacts of climate change will be given for specific areas of the SDZ within Section 5.

5 Approach to Flood Risk Management

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 on a settlement basis is achieved through the application of the policies and objectives contained within Section 7.3.0 'Flood Risk Management' of the South Dublin County Council Development Plan 2016-2022. These have been outlined in Section 2.3 of the Draft Planning Scheme.

The use and application of the policies and guidelines for the SDZ constitutes the formal plan for flood risk management for Clonburris SDZ.

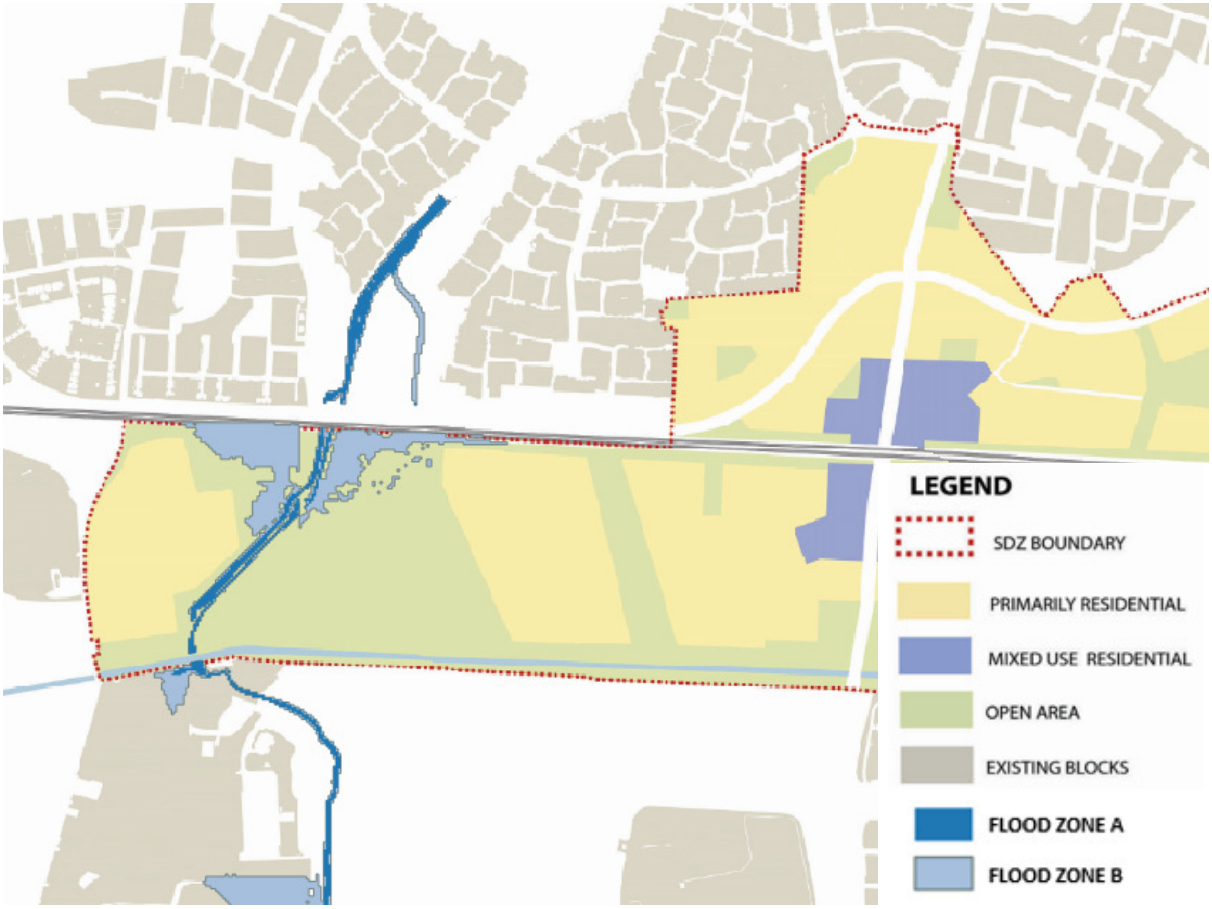
5.1 The Strategic Approach

A strategic approach to the management of flood risk is important in Clonburris as it is primarily a greenfield development site, without any existing development in Flood Zone A/B. Therefore, the SDZ represents a clear opportunity to integrate the Guidelines at an early stage in the statutory process.

The Clonburris SDZ lands are zoned - 'SDZ - to provide for strategic development in accordance with approved planning schemes' in the South Dublin County Council Development Plan 2016-2022. Having reviewed the proposed land uses within the SDZ Draft Planning Scheme, there is no overlap between zoned undeveloped lands that are subject to vulnerable uses and Flood Zone A or B. There is also no existing development that is at potential risk of flooding. Figure 5-1 over page displays the Flood Zone mapping for the western part of the SDZ (there are no Flood Zones in the east), the mapping is reproduced in Appendix A which includes the entire SDZ boundary.

Given that the sequential approach has been applied, the requirement for site specific FRAs on most types of development within the SDZ is limited, consideration of the drainage strategy for each site is the overriding flood risk management measure at development management stage and this is discussed further in section 5.2.

Figure 5-1: Proposed Land Uses and Flood Zones



5.2 Management of Surface Water

The management of surface water within the site 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.

In this regard, attenuation of both individual plots and the associated road infrastructure inclusive of public open spaces will be required. As outlined in the SWS, discharge and associated attenuation will be as follows:

- Individual Plots
    - Discharge at 2l/sec/ha with on-site storage for the 1 in 100 year event plus 20% climate change;

- Roads and Public Realm Areas
    - Discharge at 2 l/sec/ha with detention and regional retention ponds catering for the 1 in 100 year event plus 20% climate change.

The SWS outlines 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 to maintain the existing greenfield runoff rates and reducing the amount of surface water entering the piped sewer system. The surface water will be discharged into the Griffeen and Camac watercourses.

There are significant flooding issues along the Camac River (outside of the SDZ boundary). As assessed under the Eastern CFRAM Study, the risk presented by the Griffeen is less significant with only three properties impacted downstream of the Clonburris settlement boundary. Both watercourses are discussed in Section 4.3. As no flood relief works have been carried out to resolve the issues downstream on the Camac or Griffeen, development of the SDZ and the management of stormwater is a key issue. The focus of the strategy is 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.

Given the known flooding related issues to the Camac River, any opportunity to reduce and or divert flows away from the Camac system should be considered and, as a minimum, be cognisant of the strategy outlined within the SWS.

Mitigation of surface water risk can be achieved through the SWS, this incorporates new and existing drainage features to control and treat surface water runoff. The guiding principles for the approach are shown in Table 5-1. The following stormwater management principles provide a basis for sustainable development of the subject SDZ lands in terms of the management and control of stormwater discharge from the site. Further detail is provided within the SWS document.

Table 5-1: SWS Principles

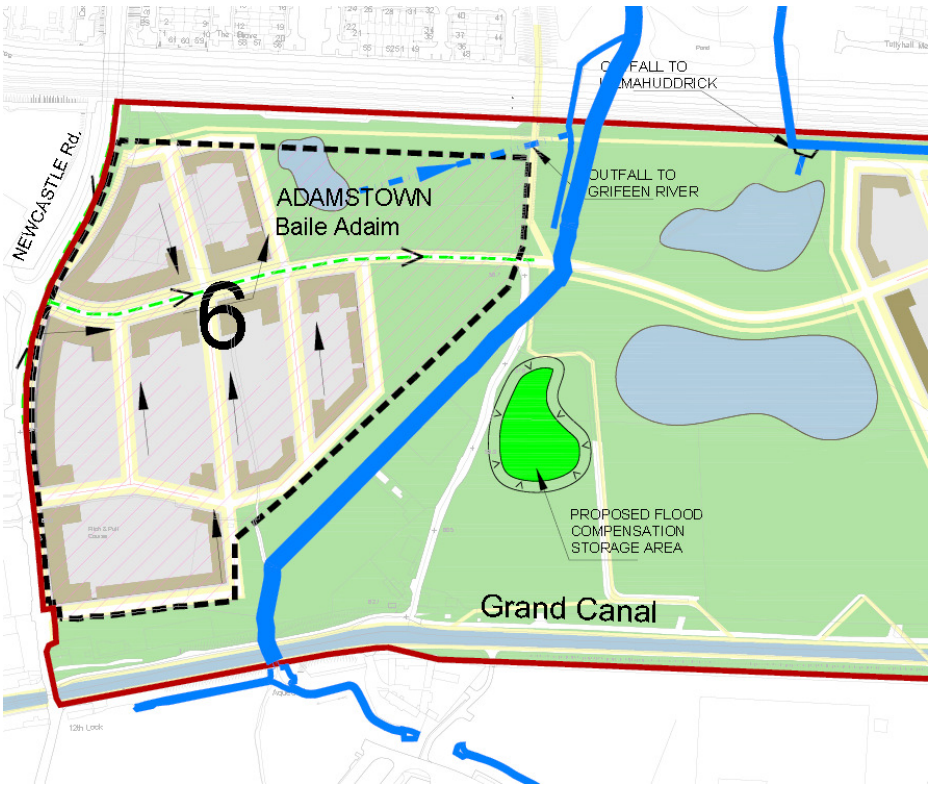
	Principle	Purpose
1	Manage surface runoff at source	Prevention or reduction of surface water flows. The GDSDS states that there should be no discharge to a surface water body or sewer from the first 5-10mm of any rainfall event.
2	Manage water on the surface	The ability to intercept flows and direct 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.
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.

5.3 Impact on Flood Zones

A small encroachment into Flood Zone B is likely for the provision of attenuation to cater for Adamstown Extension. The encroachment is mitigated by a proposed flood compensation storage area located within Griffeen Park, see Figure 5-2 below. Further details are provided within the SWMP, Section 5.6.

Figure 5-2 Strategic Drainage Approach to Adamstown Extension



5.4 Management of Residual Risk

As discussed in Section 4-6 the Grand Canal is to the south of the site and is conveyed through the area on a raised embankment. The likelihood and consequence of breach has been analysed. It has been found to be low, however, it is imperative that the canal maintenance regime continues in perpetuity.

6 SFRA Review and Monitoring

An update to the SFRA will form part of a possible review of the Planning Scheme for the SDZ, on the adoption of a new County Development Plan. This shall be agreed with South Dublin County Council. In addition, there are a number of other potential triggers for an SFRA review and these are listed in the table below.

There are several key outputs from possible future studies and datasets, which should be incorporated into any update of the SFRA as availability allows. 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.

Detailed, site specific FRAs may be submitted to support planning applications. Whilst these reports will not trigger a review of the Flood Zone maps or SFRA, they should be retained and reviewed as part of the next cycle of the SDZ.

Table 6-1 SFRA Review Triggers

Trigger	Source	Possible Timescale
Catchment Flood Risk Assessment and Management (CFRAM) Flood Hazard Mapping updates	OPW under the Floods Directive	Already published 2016 and 6 year cycles
Eastern River Basin Flood Risk Management Plan	OPW	2017, and 6 yearly reviews
Flood maps of other sources, such as drainage networks	Various	Unknown
Significant flood events	Various	Unknown
Changes to Planning and / or Flood Management Policy	DoEHLG / OPW	Unknown

APPENDIX

A Flood Zone Map