Appendix III
Strategic Flood Risk Assessment

Carlow Graiguecullen Joint Urban Local Area Plan Strategic Flood Risk Assessment

Technical Report

August 24

CARLOW COUNTY COUNCIL

COMHAIRLE CHONTAE CHEATHARLOCHA

Laois County Council

Áras an Chontae, Portlaoise, Co. Laois

JBA Project Manager

Ross Bryant BSc MSc CEnv MCIWEM C.WEM
24 Grove Island
Corbally
Limerick
Ireland

Revision History

Revision Ref / Date Issued	Amendments	Issued to
S3-P01 December 2023	Initial issue	Carlow County Council
S3-P02 December 2023	Amended issue	Carlow County Council
S3-P03 March 2024	Material Amendments	Carlow County Council
S3-P04 May 2024	Material Amendments for display	Carlow County Council
S3-P05 July 2024	CE Report updates	Carlow/Laois County Council

Contract

This report describes work commissioned by Carlow County Council. Ross Bryant and Fiona Byrne of JBA Consulting carried out this work.

Prepared by ..... Fiona Byrne BSc MSc
Analyst

Reviewed by ..... Ross Bryant BSc MSc CEnv MCIWEM C.WEM
Associate Director

Purpose

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Abbreviations

1D ..... One Dimensional (modelling)
2D ..... Two Dimensional (modelling)
AEP ..... Annual Exceedance Probability
CFRAM ..... Catchment Flood Risk Assessment and Management
DoEHLG ..... Department of the Environment, Heritage and Local Government
FARL ..... FEH index of flood attenuation due to reservoirs and lakes
FB ..... Freeboard
FFL ..... Finish Floor Levels
FRA ..... Flood Risk Assessment
FSR ..... Flood Studies Report
FSU ..... Flood Studies Update
GSI ..... Geological Survey of Ireland
LHB ..... Left Hand Bank
OPW ..... Office of Public Works
PFRA ..... Preliminary Flood Risk Assessment
RFI ..... Request for Further Information
RHB ..... Right Hand Bank
RR ..... Rainfall-Runoff
SAAR ..... Standard Average Annual Rainfall (mm)
SFRA ..... Strategic Flood Risk Assessment
URBEXT ..... FEH index of fractional urban extent
WL ..... Water Level

1 Introduction

JBA Consulting was appointed to carry out the Strategic Flood Risk Assessment for the Carlow Graiguecullen Joint Urban Area Plan 2024-2030.

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 Management1; these guidelines were issued under the Planning and Development Act 2000 and recognise the significance of proper planning to manage flood risk.

1.1 Terms of Reference and Scope

Under the "Planning System and Flood Risk Management" guidelines, the purpose for the FRA 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 Carlow Graiguecullen Joint Urban Local Area Plan 2024-2030 (JULAP) will be the key document for setting out a vision for the development of the Carlow Graiguecullen during the plan period.

It is important that the JULAP fulfils the requirements of the document “The Planning System and Flood Risk Management Guidelines for Planning Authorities” (OPW/DoEHLG, 2009) 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.

In order to ensure that flood risk is integrated into the JULAP, the main requirements of the SFRA are to:

- Produce Flood Zone Mapping for the 2024-2030 plan.
- Prepare a Stage 2 - Flood Risk Assessment for the JULAP in particular in relation to location and type of zoning and land-use proposals, with a focus on new or changed zoning compared with the current plan.
- Review and update the policy guidance within the SFRA in compliance with OPW/DoEHLG – “The Planning System and Flood Risk Management –Guidelines for Planning Authorities (OPW/DoEHLG, 2009)”.
- Take cognizance of the Carlow Climate Adaptation Strategy 2019-2024, the National Climate Adaptation Framework and the various environmental and visual designations applicable to Carlow.
- Advise on zonings/land use-proposals and appropriate mitigation measures, 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.

1.2 Report Structure

This study considers the development strategy that will form part of the Development Plan for Carlow Graiguecullen. The context of flood risk in Carlow and Graiguecullen is considered with specific reference to a range of flood sources, including fluvial, pluvial, groundwater, sewer and artificial reservoirs and canals.

A two-stage assessment of flood risk was undertaken, as recommended in 'The Planning System and Flood Risk Management' guidelines, for the area that lies within the development boundary of the Development Plan. The first stage is to review historical flooding and flood extents and make updates based on new datasets and updated land use zoning.

Historical records and recent events demonstrate that Carlow has a history of flooding and confirms that a proportion of zoned lands are at flood risk. The SFRA must protect lands for any

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

potential future flood risk management infrastructure and ensure that development within Flood Zones A/B is sustainably managed.

The second stage and the main purpose of this SFRA report is to appraise the adequacy of existing information, to prepare a Flood Zone map, based on available data, and to highlight potential development areas that require application of the Justification Test and/or more detailed assessment on a site specific level. The SFRA also provides guidelines for development within areas at potential risk of flooding, and specifically looks at flood risk and the potential for development within a number of key sites in Carlow.

Section 2 of this report provides an introduction to the study area and Section 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. This section also considers the flood management assets that are in place. Section 5 summarises the key sources of flooding.

Following this, Section 6 outlines the flood risk management policy and Section 7 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 Development Plan.

Section 8 contains the review of land use zoning objectives across the settlement it also summarises the application of the Justification Test to which specific responses are included in the Appendix.

2 Carlow Town Study Area

2.1 Introduction

The plan area comprises the full extent of Carlow Town. Carlow Town is situated on the River Barrow. The town is subject to an existing flood relief scheme. There are also two proposed flood relief schemes under consideration on the River Burrin and the Knocknagee stream. Carlow is designated as a key town within the region and as a regional and inter--regional economic growth driver and is targeted for growth under the National Planning Framework and Regional Spatial and Economic Strategy (RSES).

2.2 Watercourses

The primary watercourse in the Carlow Town area is the River Barrow which is 192km long and drains a catchment of approximately 3000km^2, making it the second longest river in Ireland. The largest tributary of the Barrow is the Burrin River which flows 39km through the county before meeting the Barrow at Carlow Town. The Barrow flows in a southerly direction through Carlow town, under Graiguecullen Bridge and over the Carlow Weir. The River Burrin flows in a north easterly direction to its confluence with the Barrow immediately downstream of Carlow Weir. The Derrymoyle stream, a tributary of the Barrow, flows c. 4km in a southerly direction where it meets the Barrow.

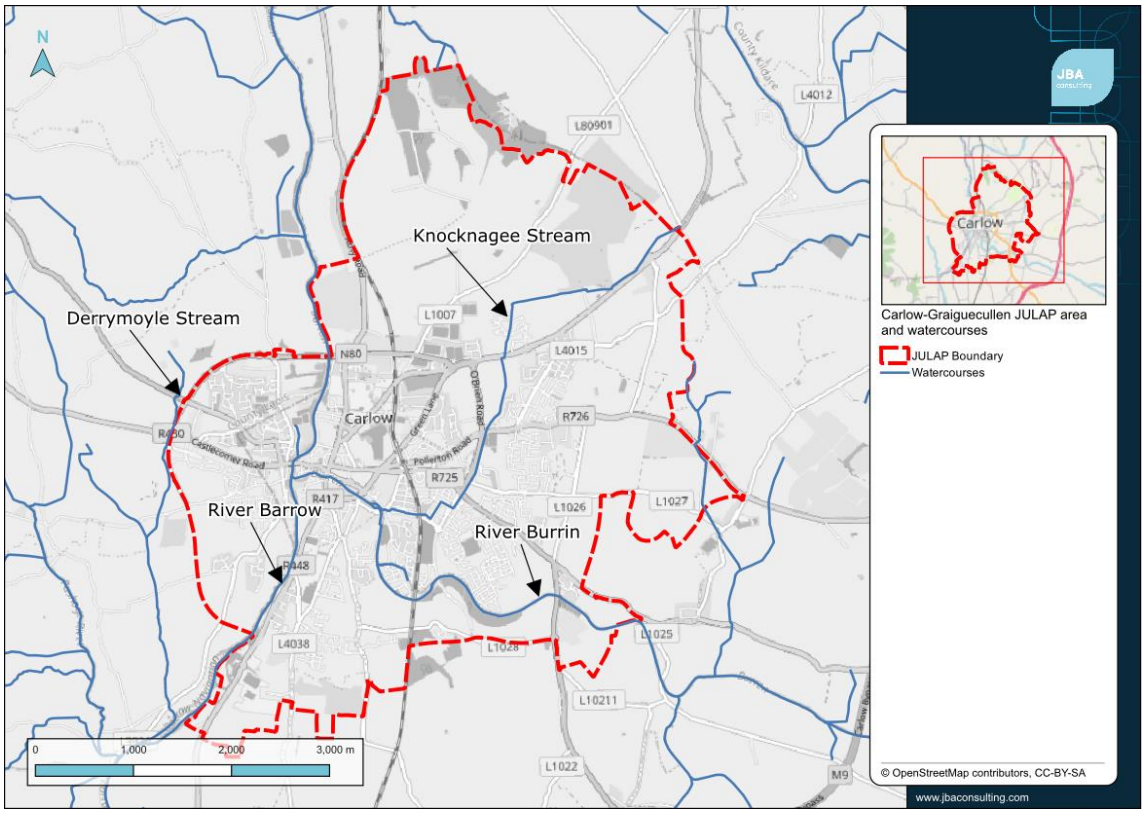


Figure 2-1 JULAP area and watercourses

2.3 Current Planning Policy

2.3.1 Ireland 2040 - National Planning Framework

A Strategic Flood Risk Assessment of the National Policy Objectives (NPO) within the Ireland 2040 – National Planning Framework was undertaken with the aim of ensuring that flood risk is a key consideration in delivering the proposed strategic sustainable land-use planning decisions. It sets out how all levels of the planning process, from national level strategic assessments to individual planning applications, should follow the sequential approach set out in the 2009 Guidelines on Planning and Flood Risk Management.

The NPF recognises that it is not always possible to avoid developing in flood risk areas due to spatial, economic, environmental and physical constraints. Development should be encouraged to continue, and in flood risk areas should follow the sequential approach and application of Justification Test set out in the Department's Guidelines on the Planning System and Flood Risk Management. These guidelines will facilitate the integration of flood risk and land risk planning in the Southern region, at all tiers of the planning hierarchy from national level through regional, city/county and local plans, masterplans and individual planning applications.

2.3.2 Regional Spatial and Economic Strategy (Southern Regional Assembly & Eastern and Midlands Region Assembly)

Carlow-Graiguecullen includes the functional area of two local authorities and two regional assemblies. The area of the town around Graiguecullen in County Laois is in the functional area of the Eastern and Midlands Region (EMRA), while the greater area of Carlow Town within County Carlow is located with the Southern Region.

The RSES' set out how Development Plans should include Strategic Flood Risk Assessments and all future zoning of land for development in areas at risk of flooding should follow the sequential approach set out in the 2009 Guidelines on Planning and Flood Risk Management (DoEHLG). The inclusion of policies and actions to support Sustainable Urban Drainage Systems is recommended in future developments as a major component of flood management and prevention.

The combined urban area of Carlow-Graiguecullen functions as a key regional centre for economic activity, education, healthcare, public services, retailing, arts, culture, and recreation. The core of the urban area in Carlow-Graiguecullen (i.e., Carlow Town) is located to the east of the River Barrow and within County Carlow. A part of the urban area comprising Graiguecullen is located to the west of the river and is partly located within County Laois. Being strategically located c.90km from Dublin and Waterford city, the joint urban area benefits from strong ties with the Greater Dublin Area, the Midlands, as well the Southern Region.

The Regional Spatial and Economic Strategies (RSES') for the Southern Region and the Eastern and Midlands Region (EMRA) seek to implement the NPF at a regional level. The designation of Carlow-Graiguecullen as a Key Town is a strategic issue for both regional policy documents and is recognition of the population, and the economic and employment scale of the town. These factors contribute to the town's role as a self-sustaining regional driver and its inter-regional role due to its strategic location in both regions. At the regional level settlement hierarchy, it is a function of Key Towns like Carlow-Graiguecullen to ensure a consolidated spread of growth beyond the five cities.

The settlement hierarchy selected by the RSES takes account of the fact that while Carlow-Graiguecullen, is vulnerable to fluvial flooding, wider, effective management of flood risk coupled with wider environmental, sustainability and economic considerations mean that it is possible to facilitate the continued consolidation of the development of the existing urban structure of the region. In line with the sequential and justification criteria set out in the Department's Guidelines on the Planning System and Flood Risk Management it is considered that these locations should be encouraged to continue to consolidate and to grow in order to bring about a more compact and sustainable urban development form while at the same time managing flood risk appropriately. These guidelines outline measures through which both the flood risk and the continued development of Carlow-Graiguecullen,

The RSES' included a number of development plan implications:

- An integrated approach to river catchment management is essential to manage and avoid increasing flood risk. Local authorities should fully support the completion of CFRAM studies and jointly implement any actions identified.
- Development Plans shall include Strategic Flood Risk Assessments and all future zoning of land for development in areas at risk of flooding should follow the sequential approach and Justification Test set out in the 2009 Department Guidelines on Planning and Flood Risk Management.
- Development Plans should include policies on the requirement for Sustainable Drainage Systems (SuDS) in future developments as a major component of flood management and prevention.

- Development and Local Area Plans in the region should take account of and incorporate the recommendations of the Flood Risk Management Plans, including planned investment measures for managing and reducing flood risk. Natural Water Retention Measures (NWRMS) should be incorporated where appropriate.

2.3.3 Carlow County Development Plan 2022-2028

As part of the Carlow County Development Plan 2022-2028 a Strategic Flood Risk Assessment was undertaken. The purpose of the SFRA is to provide a broad assessment of all types of flood risk to inform strategic land use planning decisions. Parts of County Carlow are vulnerable to flooding and are mapped as part of the Carlow County Development Plan 2015-2021

The flood management policies of Carlow County Council, as laid out in the development plan include:

- Carry out flood risk assessment for the purpose of regulating, restricting and controlling development in areas at risk of flooding and to minimise the level of flood risk to people, business, infrastructure and the environment through the identification and management of existing and potential future flood risk;
- Lower tier plans shall undertake Strategic Flood Risk Assessment in accordance with the requirements of the Planning System and Flood Risk Management-Guidelines for Planning Authorities (DEHLG and OPW, 2009);
- Apply the sequential approach which is based on the principles of avoidance, reduction and mitigation of flood risks when preparing town development plans and local area plans and when assessing planning applications for development proposals;
- Require the use of Sustainable Urban Drainage Systems (SuDS) to minimise the extent of hard surfacing and paving and require the use of sustainable drainage for new development or extensions to existing developments;
- 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;
- Preserve appropriately sized riparian strips alongside river channels free of development and of adequate width to permit access for river maintenance;
- Integrate as appropriate the recommendations of any relevant CFRAM Studies, Flood Risk Management Plans, future flood hazard maps or flood risk maps;
- Ensure that where flood protection or alleviation works take place that the natural and cultural heritage and rivers, streams and watercourses are protected and enhanced. Such works will be subject to Appropriate Assessment as required under Article 6 of the EU Habitats Directive;
- Ensure that development proposals in areas at moderate (Flood Zone B) or high (Flood Zone A) risk of flooding which are considered acceptable in principle demonstrate that appropriate mitigation measures can be put in place and that residual risks can be managed to acceptable levels;
- Site-specific Flood Risk Assessment (FRA) is required for all planning applications in areas at risk of flooding, even for developments appropriate to the particular Flood Zone. The detail of these site-specific FRAs will depend on the level of risk and scale of development. A detailed site-specific FRA should quantify the risks, the effects of selected mitigation and the management of any residual risks. The Council shall have regard to the results of any CFRAM Study in the assessment of planning applications;
- Support, in co-operation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No. 122 of 2010) and the DEHLG/OPW publication The Planning System and Flood Risk Management Guidelines (2009) (and any updated/superseding legislation or policy guidance). Carlow County Council will also take account of the South Eastern Catchment Flood Risk Assessment and Management Study;
- Protect water bodies and watercourses within the County from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands

and natural floodplains. This will include protection buffers in riverine and wetland areas as appropriate. For larger river channels (over 10m), the recommended width of the core riparian core (CZR) is 35-60m (18-30m on each side of the river) and may be larger where flood plains adjoin the riparian zone. For smaller channels (under 10m), a core riparian zone (CZR) of 20m or greater (minimum 10m on each side of the river) is recommended.

- In addition, the Specific Objective for Flood Risk Management requires a detailed site-specific FRA for identified potential flood risk areas, taking into consideration findings of the CFRAM Study when completed.

2.3.4 Laois County Development Plan 2021 - 2027

As part of the Laois County Development Plan 2017-2023 a Strategic Flood Risk Assessment was undertaken. The purpose of the SFRA is to provide a broad assessment of all types of flood risk to inform strategic land use planning decisions. Parts of County Laois are vulnerable to flooding and are mapped as part of the Laois County Development Plan 2017-2023.

The Laois County Development Plan 2017-2023 considered flood risk with specific reference to people, business, infrastructure and the environment at risk of flooding. The LCDP proposed to minimise the risk of flooding through the identification and management of existing, and particularly potential future, flood risks.

The flood management policies of Laois County Council, as laid out in the development plan include:

- Ensure that flood risk management is incorporated into the preparation of all local area plans through the preparation in accordance with the requirements of the Planning System and Flood Risk Management-Guidelines for Planning Authorities (DoEHLG 2009).
- Ensure that all development proposals comply with the requirements of the Planning System and Flood Risk Management-Guidelines for Planning Authorities' (DEHLG 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 and new development does not increase flood risk elsewhere, including that which may arise from surface water runoff.
- Support the implementation of recommendations in the CFRAM Programme to ensure that flood risk management policies and infrastructure are progressively implemented.
- Support the implementation of recommendations in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk. 221 Flood Risk Management Policy Objectives
- Consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible, and to retain a strip on either side of such channels where required, to facilitate maintenance access thereto.
- Assist the OPW in developing catchment-based Flood Risk Management Plans for rivers in County Laois and have regard to their provisions/recommendations.
- Protect and enhance the County's floodplains and wetlands as 'green infrastructure' which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future, subject to normal planning and environmental criteria.
- Protect the integrity of any formal (OPW or Laois County Council) flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defence infrastructure or compromise any proposed new infrastructure.
- Ensure that where flood risk management works take place that the natural and cultural heritage, rivers, streams and watercourses are protected and enhanced.
- Ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan Flood Risk Management applicable at the time.
- Consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the provision of flood alleviation measures in the County.

- Prioritise plans for flood defence works in the towns as indicated in the Strategic Flood Risk Assessment in order to mitigate against potential flood risk.
- Ensure new development does not increase flood risk elsewhere, including that which may arise from surface water runoff.
- Protect water sinks because of their flood management function, as well as their biodiversity and amenity value and encourage the restoration or creation of water sinks as flood defence mechanisms, where appropriate.

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 in order 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.

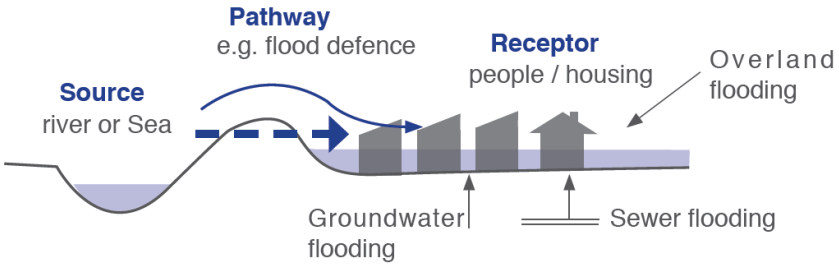


Figure 3-1: Source Pathway Receptor Model

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.

3.3 Likelihood of Flooding

Likelihood or probability of flooding of 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.

3.4 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 guidelines provide 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.

3.5 Definition of Flood Zones

In the Planning System and Flood Risk Management guidelines, Flood Zones are used to indicate the likelihood of a flood occurring. These Zones indicate a high, moderate or low probability 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 take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

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).

3.6 Objectives and Principles of the Planning Guidelines

The Planning System and Flood Risk Management Guidelines describe 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 Guidelines 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 a number of 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.

3.7 The Sequential Approach & Justification Test

Each stage of the Flood Risk Assessment (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 development plan. 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.

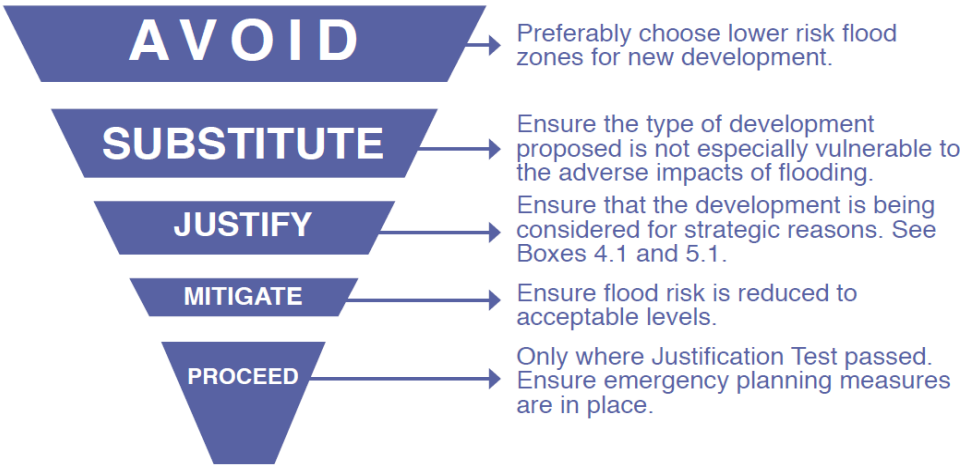


Figure 3-2: Sequential Approach Principles in Flood Risk Management

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 application of the Justification Test. Many towns 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 assess 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 High Probability	**Flood Zone B Moderate Probability**	**Flood Zone C Low Probability**
Highly Vulnerable Development (Including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

3.8 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 of:

Regional Flood Risk Assessment (RFRA) – a broad overview of flood risk issues across a region to influence spatial allocations for growth in housing and employment and 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 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 and Review

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

Table 4-1: Available Flood Data for Flood Zone Development

Description	Coverage	Robustness	Comment on usefulness
South Eastern CFRAM Flood Mapping	Covers the river Barrow and its tributaries	High AFA status	Detailed 1D/2D CFRAM HPW model and is useful. Site verified by walkover and consultation with local authority. In general, CFRAM provides all information needed to apply the Justification Test (JT) for Plan Making under the SFRA. Area is listed for update under the OPW map review programme and this will be updated in the County Flood Zones when available.
National Indicative Fluvial Mapping (OPW)	Watercourses to the west of Carlow Town	Low	This data is broadscale and based on remotely sensed ground models. There is no modelled water level or depth associated with this dataset. Has been screened out at this stage due to a concern with the quality of data following a meeting with OPW. These flood extents are not suitable for use to assess flood risk and have not been used to define the Flood Zones.
Historical Flood Event Outlines	Coverage of most of LAP area from previous flood event	Moderate	Used indirectly to validate flood zones. Useful background information for flooding in specific areas of the settlement.

Table 4-2 Other Available Data

Description	Coverage	Robustness	Comment on usefulness
GSi Groundwater and Surface Water flood information	Full Study Area	Moderate	Provides both historic and predictive flood extents for groundwater and historic surface water flooding.
Alluvial Soils Maps	Full Study Area	Low	Used to provide indication of risk in areas with no other mapping available.
Groundwater vulnerability maps	Broadscale, County wide	Moderate	Initial assessment of groundwater vulnerability. Provides a screening tool for use in FRA.
Site Walkover	Specific areas of interest	Moderate	Helpful for assessing flood risk in areas where mapping is unavailable. Used to verify existing mapping and
Historic Flood Records including photos, aerial photos and reports.	Coverage of most of LAP area from 2009 flood	Various	Highly useful oversight of historic flooding issues provided by Local Authority.

	event and spot coverage for other events		
LiDAR height model	Carlow area	High	Aerial survey is used to appraise the topography and identify low spots, floodplain and areas potentially susceptible to flooding.

As set out in the RSES Regional Flood Risk Appraisal Report, and under the Planning Guidelines, the Flood Zone mapping for Carlow is principally derived from the CFRAM where possible.

All sources of available flood mapping were reviewed, and the best available dataset is used.

Specific guidance is provided for each area Carlow Town based on the data review and the site visit is used to confirm the most appropriate dataset and flood extents to define the Flood Zones. During the site visit (attended by Local Authority Engineers and Planners) the flood mapping was appraised on site by an experienced flood risk manager and professional opinion and judgement has been used to develop the recommendations within the Settlement Review of Section 8.

- The review of the suite of flood risk data has been developed as a spatial planning tool to guide CCC in making land-use zoning and development management decisions. The data sets have been deemed appropriate for the planning decisions being made at this stage of the plan making process and where flood risk is identified the following approach has been undertaken;
- Application of the Justification Test and/or;
- Further detailed analysis, or;
- Rezoning to a less vulnerable use, or;
- Further assessment at Development Management stage in limited circumstances where it has been determined that development should be possible in principle, taking into account a site specific opinion.

Where CFRAM modelling has been carried out, flood levels are available at selected node points along the watercourse. Once an appropriate level of validation has been undertaken as part of the site-specific FRA, these flood levels may be used to form the basis of the development design.

4.1 Historic Flooding

A number of areas in the Carlow and Graiguecullen area have been affected by flooding historically. Several sources were consulted to identify previous flood events including the OPW floodinfo.ie website, newspaper articles and previous flood studies. Floodinfo.ie provides information on historical flood events across the country and formed the basis of the Regional Flood Risk Assessment. Information is provided in the form of reports and newspaper articles which generally relate to rare and extreme events. A map of affected areas is shown in Figure 4-1

Location	Start Date	Description
Carlow	March 1947	Flooding in the town centre from River Barrow.
Carlow Town	February and June 1990	Flooding due to high rainfall and overtopping of Barrow
Barrlow and Burrin, Carlow	Jan/Feb 1995	Flooding due to high rainfall and overtopping of Rivers Barrow and Burrin.
Barrow, Carlow Town	18/08/2008	Several areas of the town centre flooded due to overtopping of the Barrow after heavy rainfall.
Carlow Town	27/11/2009	Severe flooding was recorded between the 19th and 27th of November 2009 after the Barrow burst its banks following prolonged period of heavy rain. A maximum flood depth of 1.5m was recorded during this time and 33 residential and 16 commercial properties were affected by the flooding
Carlow town	Recurring	Carlow town is subject to recurring flooding. Locations vulnerable to flooding include: Carlow Town Centre, • Paupish Lane (Alleviation works have increased the level of protection to Paupish Lane), • Dr Cullen Road (Lack of capacity of surface water drainage system. Will be alleviated following Carlow Main Drainage Scheme), • Green Lane (Road lowered beneath railway bridge. Deficiencies in surface water drainage.), • Askagh Drive Pollerton (Lack of capacity of surface water drainage system. To be alleviated following Carlow Main Drainage Scheme), • Green Road Ballycarney (Lack of capacity of surface water drainage system) • Ballynakillbeg, • Pollerton Big (Lack of capacity of surface water drainage), • Ford Bridge, • Ballinacarrig (Alleviation works have reduced severity of flooding), • Oak Park Entrance.

-2 Historic Flooding (floodinfo.ie)

4.1.1 Carlow Flood Relief Scheme

The Carlow Flood Relief Scheme was initiated in 1996 following severe flooding in 1995 and was constructed from 2010 to 2013. The Scheme, which comprises flood defence walls and embankments along the River Barrow and Burrin Stream with a pumping station at their confluence which provides protection against fluvial flooding to the 1% AEP for 185 properties. The flood relief scheme also includes some weir alterations and channel improvement works.

Further works on the Burrin River in the Mill Race/Springfield area and on the Knocknagee Stream in the Castle Oaks area were recommended by the CFRAM and have been included as part of the first 50 FRSs to be investigated further under the 10-year government spending plan announced in May 2018.

4.2 Site Walkover

As part of the SFRA process a site walkover and consultation was undertaken in Carlow Town by an experience Flood Risk Manager alongside the Local Authority Engineer. The site walkover aimed to assess risks presented by potentially unmapped watercourses and to verify CFRAM mapping.

The walkover took place at specific locations throughout Carlow Town based on CFRAM and OSi mapping. The CFRAM mapping was also found to be in agreement with observations made during the walkover.

4.3 GSI Groundwater Flood

The winter of 2015/2016 saw the most extensive groundwater flooding ever witnessed in Ireland. The lack of data on groundwater flooding and fit-for-purpose flood hazard maps were identified as serious impediments to managing groundwater flood risk in vulnerable communities. Geological Survey Ireland - in collaboration with Trinity College Dublin and Institute of Technology Carlow - initiated the groundwater flood project GWFlood to address these deficits. Data available as a result of the project include national-scale flood maps for both historic and predictive groundwater flooding.

The historic groundwater flood map is primarily based on the winter 2015/2016 flood event, which in most areas represented the largest groundwater flood event on record. The map was produced based on the SAR imagery of the 2015/2016 event as well as any available supplementary evidence.

The predictive groundwater flood map presents the probabilistic flood extents for locations of recurrent karst groundwater flooding. It consists of a series of stacked polygons at each site representing the flood extent for specific AEP's mapping floods that are expected to occur every 10, 100 and 1000 years (AEP of 0.1, 0.01, and 0.001 respectively). The map is focussed primarily (but not entirely) on flooding at seasonally inundated wetlands known as turloughs. Sites were chosen for inclusion in the predictive map based on existing turlough databases as well as manual interpretation of SAR imagery.

The mapping process tied together the observed and SAR-derived hydrograph data, hydrological modelling, stochastic weather generation and extreme value analysis to generate predictive groundwater flood maps for over 400 qualifying sites. It should be noted that not all turloughs are included in the predictive map as some sites could not be successfully monitored with SAR and/or modelled.

The maximum historic groundwater flood mapping is displayed over page in Figure 4-3 which shows a small area of historic flooding in the north of the area and in the south. The Predictive mapping however, shows no predicted groundwater flooding within or close to the LAP boundary.

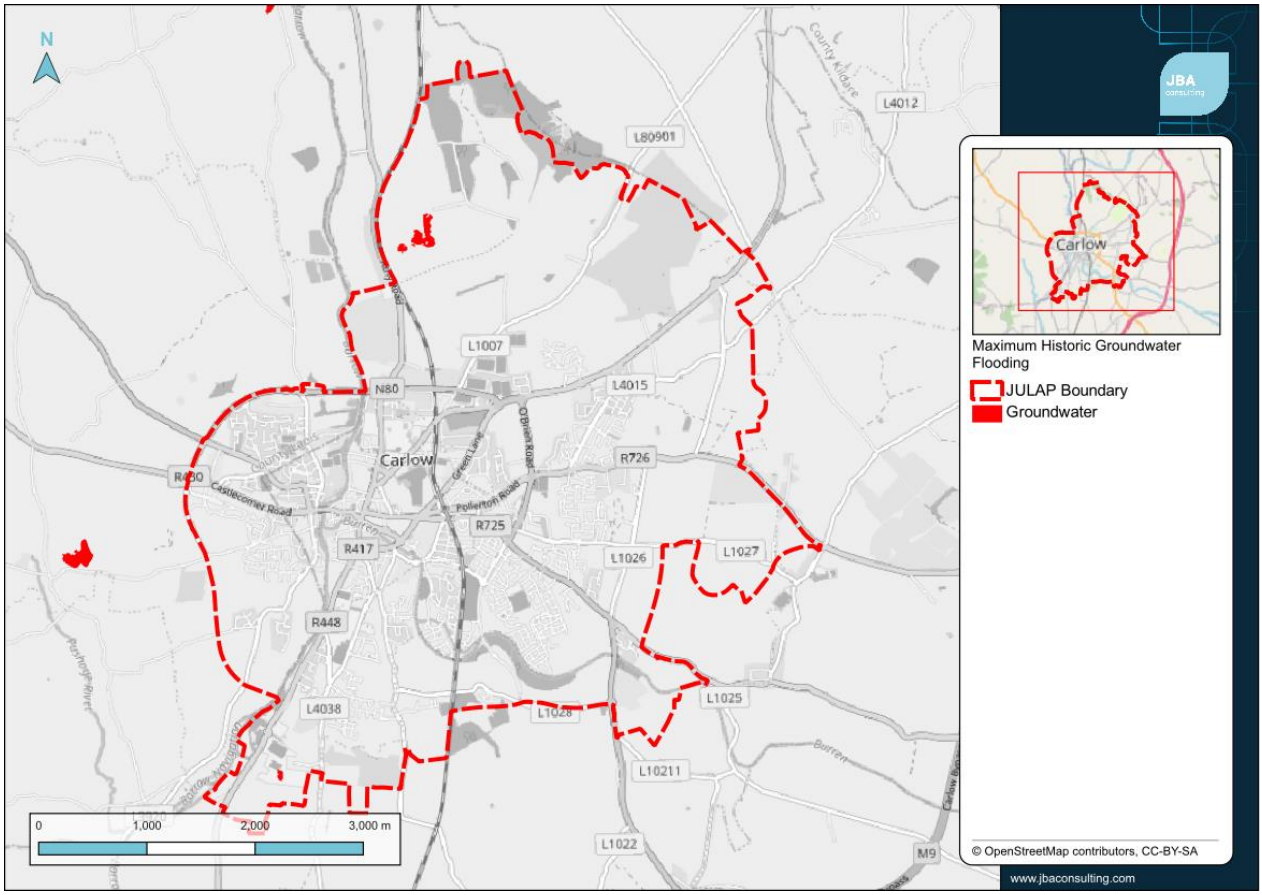


Figure 4-3 Maximum Historic Groundwater Flooding

4.4 GSI Surface Water Flooding

Geological Survey Ireland - in collaboration with Trinity College Dublin and Institute of Technology Carlow - initiated the groundwater flood project GWFlood to address deficits in groundwater flooding and fit-for-purpose flood hazard maps.

In addition to the historic groundwater flood map, the flood mapping methodology was also adapted to produce a surface water flood map of the 2015/2016 flood event. This flood map encompasses fluvial and pluvial flooding in non-urban areas and has been developed as a separate product. The historic surface water flood map is displayed within Figure 4-4 and was reviewed on site during the walkover.

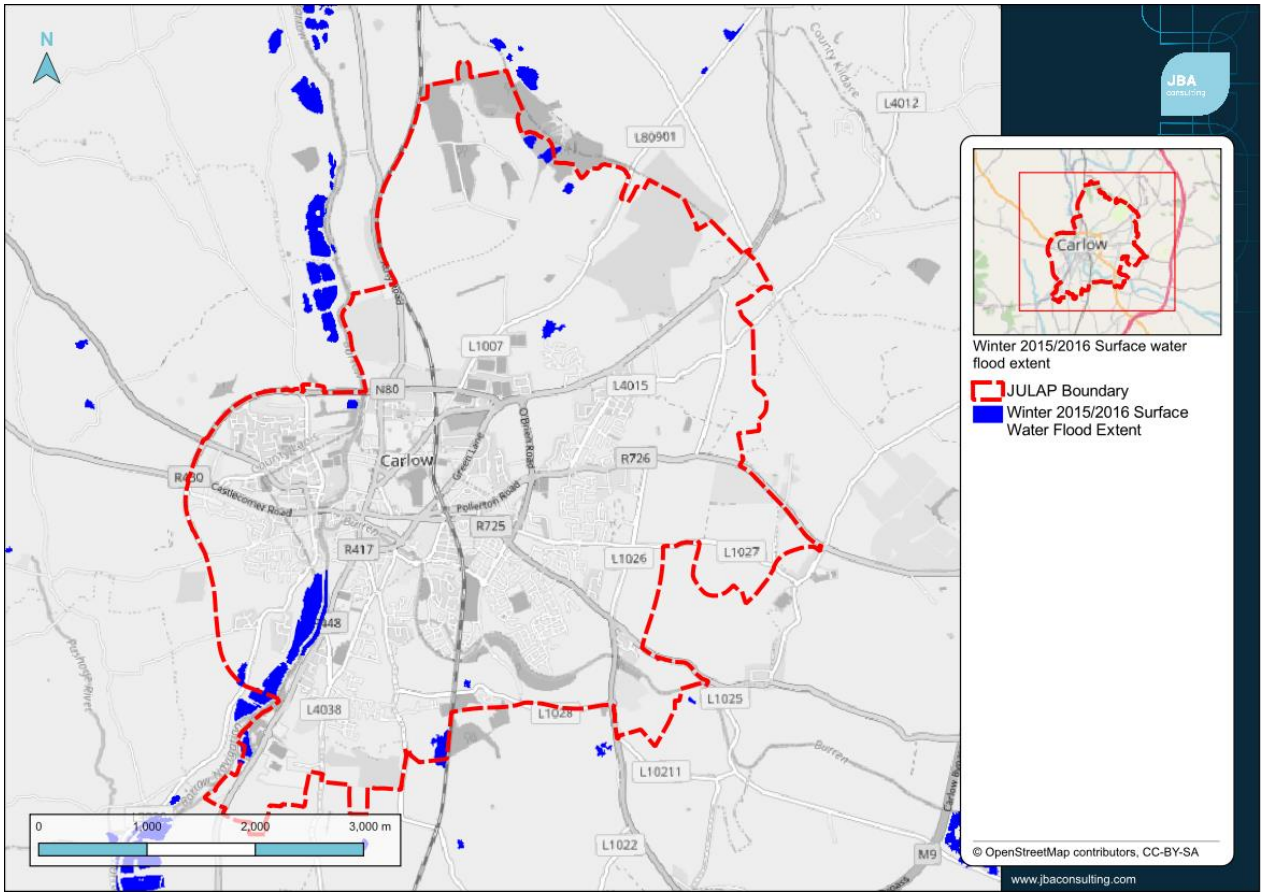


Figure 4-4 Winter 2015/2016 Surface water flood extent (GSI)

4.5 CFRAM

In 2011 the OPW commenced appointment of consultants to carry out a more detailed flood risk assessment on key flood risk areas. This work was undertaken under the CFRAM programme across seven river basin districts in Ireland. The South Eastern RBD includes the entire catchment of the River Barrow, covering some 13,000km^2 and 20% of the country. The RBD covers parts of 7 counties: Carlow, Kildare, Kilkenny, Laois, Tipperary, Waterford and Wexford.

The initial Flood Risk Review (FRR) stage of the of the South Eastern CFRAM included a site-based review of the PFRA flood outlines at a number of settlements. Several communities were identified through this process as being at potentially significant flood risk in the South Eastern River Basin, which included Carlow Town. Following this review, any sites recommended as an Area for Further Assessment (AFA) were included in the subsequent detailed assessment stage of each CFRAM study.

A set of flood maps, indicating the areas prone to flooding, has been developed and published for the Joint Urban Area Plan. The Plan builds on and supplements the national programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes.

Climate change is likely to have a considerable impact on flood risk in Ireland, such as through rising mean sea levels, increased wave action and the potential increases in winter rainfall and intense rainfall events. Land use change, for example, through new housing and other developments, can also increase potential future flood risk. In order to assess this risk, the South East CFRAM study also included detailed assessments of flooding and impacts for potential future climate change scenarios.

The 1% AEP and 1% AEP + climate change outlines are displayed over page in Figure 4-5 Results confirm a generally high impact of climate change across the settlement with the HEFS mapping aligning with the 0.1% current flood extent.

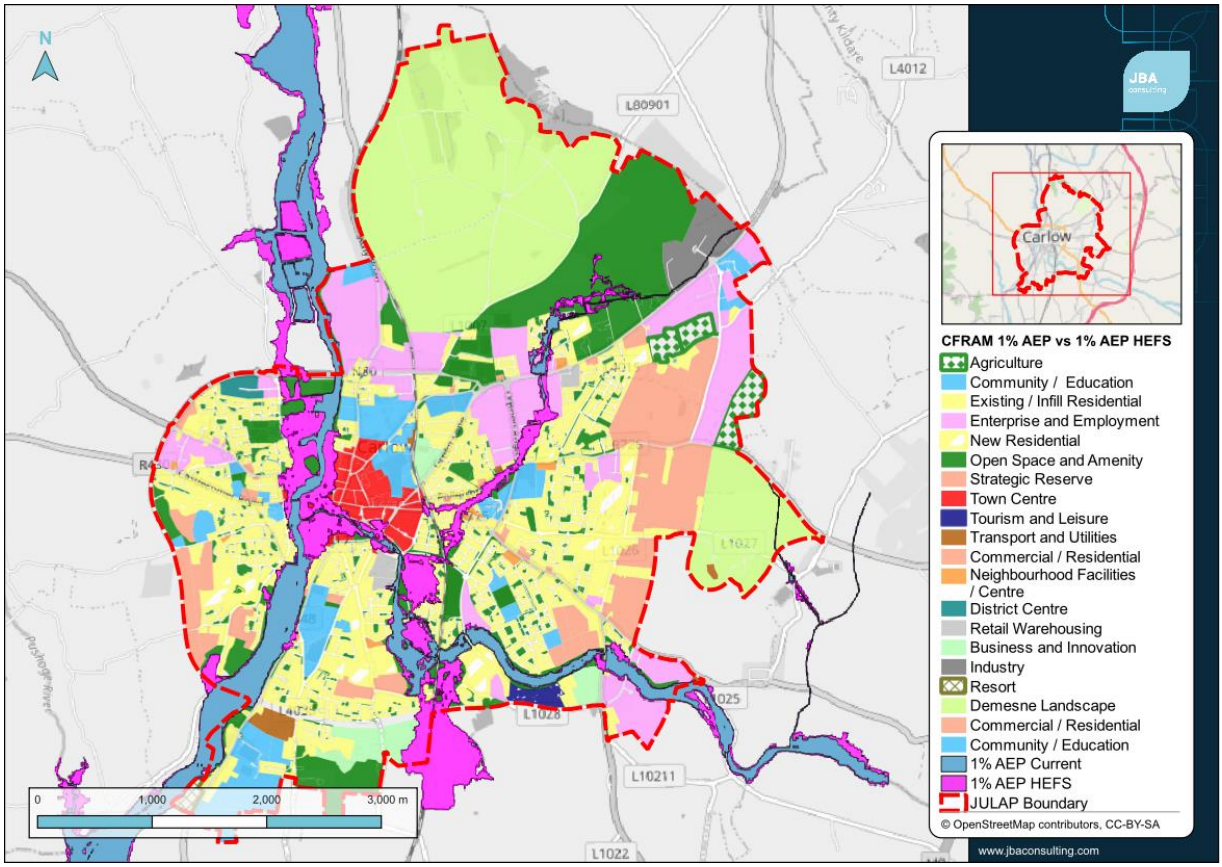


Figure 4-5 CFRAM 1% AEP vs 1% AEP HEFS

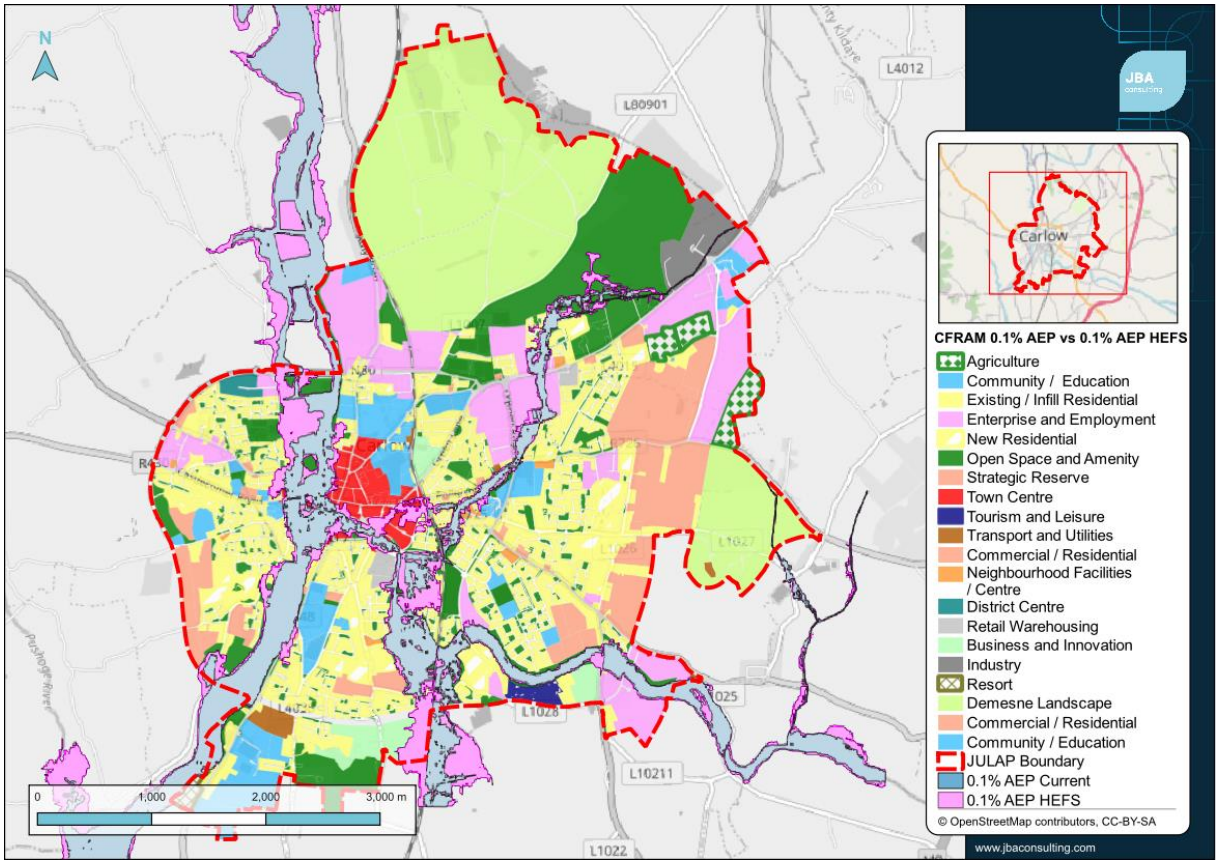


Figure 4-6 CFRAM 1% AEP vs 0.1% AEP HEFS

5 Sources of Flooding

This SFRA has reviewed flood risk from fluvial, pluvial and groundwater sources. Flooding events have become more pronounced in Ireland, and Carlow, A review of the historical event data and predictive flood information has highlighted a number of sources of potential flood risk to the town. These are discussed in the following sections.

5.1.1 Fluvial Flooding

Flooding from rivers and streams is associated with the exceedance of channel capacity during higher flows. The process of flooding from watercourses depends on numerous characteristics associated with the catchment including; geographical location and variation in rainfall, steepness of the channel and surrounding floodplain and infiltration and rate of runoff associated with urban and rural catchments. Generally, there are two main types of catchments; large and relatively flat or small and steep, both giving two very different responses during large rainfall events.

In a large, relatively flat catchment, flood levels will rise slowly, and natural floodplains may remain flooded for several days or even weeks, acting as the natural regulator of the flow. In small, steep catchments local intense rainfall can result in the rapid onset of deep and fast-flowing flooding with little warning. Such “flash” flooding, which may only last a few hours, can cause considerable damage and possible risk to life.

5.1.2 Flooding from Defence Overtopping or Breach

There is a flood relief scheme in Carlow Town which was completed in 2013. There are also plans to progress the development of Flood Relief Schemes in Carlow to augment the existing Scheme.

In addition to the defences in place as part of this scheme there will also be a number of walls and other structures which, whilst not designed to act as flood defences, provide a level of protection against flood water.

Existing development clearly benefits from the construction of defences, and new defences will be considered as one means of facilitating the redevelopment of the settlements. However, it is against sustainability objectives, and the general approach of the OPW, to construct defences with the intention of releasing green field land for development. It is also not appropriate to consider the benefits of schemes which have not been constructed or which may only be at pre-feasibility or design stage.

Residual risk is the risk that remains after measures to control flood risk have been carried out. Residual risk can arise from overtopping of flood defences and / or from the breach from structural failure of the defences.

The concept of residual risk is explained in ‘The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009' as follows:

"Although flood defences may reduce the risk of flooding, they cannot eliminate it. A flood defence may be overtopped by a flood that is higher than that for which it was designed or be breached and allow flood water to rapidly inundate the area behind the defence. In addition, no guarantee can be given that flood defence will be maintained in perpetuity. As well as the actual risk, which may be reduced as a result of the flood defence, there will remain a residual risk that must be considered in determining the appropriateness of particular land uses and development. For these reasons, flooding will still remain a consideration behind flood defences, and the flood zones deliberately ignore the presence of flood defences."

Overtopping of flood defences will occur during flood events greater than the design level of the defences. Overtopping is likely to cause lower levels of inundation of the floodplain than if defences had not been built, but the impact will depend on the duration, severity and volume of floodwater. However, and more critically, overtopping can destabilise a flood defence, cause erosion and make it more susceptible to breach or fail. Recovery time and drainage of overtopping quantities should also be considered. Overtopping may become more likely in future years due to the impacts of climate change and it is important that any assessment of defences includes an appraisal of climate change risks.

Breach or structural failure of flood defences is hard to predict and is largely related to the structural condition and type of flood defence. 'Hard' flood defences such as solid concrete walls are less likely to breach than 'soft' defence such as earth embankments. Breach will usually result

in sudden flooding with little or no warning and presents a significant hazard and danger to life. There is likely to be deeper flooding in the event of a breach than due to overtopping.

Whilst it is important that residual risks are recognised and appropriate management measures put in place, it is also important to acknowledge the benefits that a flood relief scheme provides to those living and working behind it. In this regard, although 'The Planning System and Flood Risk Management Guidelines for Planning Authorities and Technical Appendices, 2009' requires flood zones to be undefended, consideration should be given to the benefit provided by flood defences, but only once the Justification Test has been applied and passed.

5.1.3 Pluvial Flooding

Flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. The resulting water follows along natural valley lines, creating flow paths along roads and through and around developments and ponding in low spots, which often coincide with fluvial floodplains. Any areas at risk from fluvial flooding will almost certainly be at risk from surface water flooding.

The PFRA study considered pluvial flood risk and produced a national set of pluvial flood maps. This dataset was reviewed and used to identify development areas at particular risk of surface water and pluvial flooding. However, the level of detail contained in the PFRA map, and the widespread distribution of areas at risk did not allow a commentary relating to pluvial flood risk to be developed, or for particularly high-risk areas to be identified. Instead, an overall strategy for the management of pluvial risk is presented and should be implemented across all development proposals. This, and recommendations for the assessment of surface water risks, are provided in the Flood Risk Management Policy section.

5.1.4 Flooding from Drainage Systems

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity, it becomes blocked, or it cannot discharge due to a high-water level in the receiving watercourse.

Flooding in urban areas can also be attributed to sewers. Sewers have a finite capacity which, during certain load conditions, will be exceeded. In addition, design standards vary and changes within the catchment areas draining to the system, in particular planned growth and urban creep, will reduce the level of service provided by the asset. Sewer flooding problems will often be associated with regularly occurring storm events during which sewers and associated infrastructure can become blocked or fail. This problem is exacerbated in areas with under-capacity systems. In the larger events that are less frequent but have a higher consequence, surface water will exceed the sewer system and flow across the surface of the land, often following the same flow paths and ponding in the same areas as overland flow.

Foul sewers and surface water drainage systems are spread extensively across the urban areas with various interconnected systems discharging to treatment works and into local watercourses.

5.1.5 Drainage Districts

Another form of fluvial regime is seen within the JULAP area is related to rivers that have been subject to works as part of a drainage programme. Drainage Districts were carried out by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding. Channels and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified and various other work was carried out.

The purpose of the schemes was to improve land for agriculture, by lowering water levels during the growing season to reduce waterlogging on the land beside watercourses known as callows.

Drainage Districts cover approximately 10% of the country, typically the flattest areas.

Local authorities are charged with responsibility to maintain Drainage Districts. The Arterial Drainage Act, 1945 contains a number of provisions for the management of Drainage Districts in Part III and Part VIII of the act. The Act was amended on a number of occasions, e.g. to transpose EU Regulations and Directives such as the EIA, SEA, and Habitats Directives and the Aarhus Convention.

Through the implementation of these schemes the hydraulic conveyance efficiency of a catchment is increased, thereby leading to a reduction in overland flood storage. Although it has been found that these schemes generally achieve their main objectives, this increase in discharge-carrying capacity leads to an acceleration of the response to rainfall with flood peaks of increased intensity and more rapid recessions.

The Barrow, Quinagh and Burren Drainage Districts are located within the JLAP (see Figure 5-1 below) and typically ensure that flood waters (of varying magnitude but typically the 3-year flood) are retained in bank by lowering water levels during the growing season thus reducing waterlogging on the adjacent land during wetter periods.

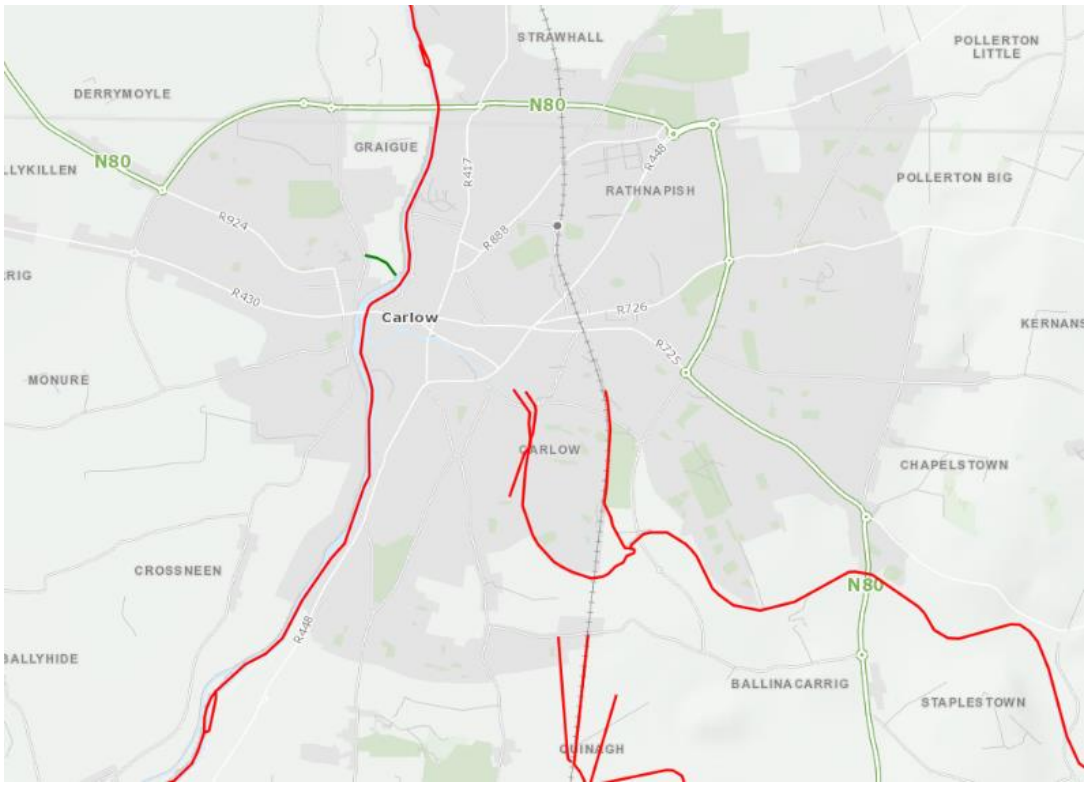


Figure 5-1 Local Drainage Districts

5.1.6 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from underground and is particularly common in karst landscapes. This can emerge from either point or diffuse locations. The occurrence of groundwater flooding is usually very local and unlike flooding from rivers and the sea, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas and pose further risks to the environment and ground stability. Flood risk relating to groundwater has been screened under Section 4.3 and confirmed that Carlow is not at risk from predicted groundwater flooding.

6 Flood Risk Management Policy

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 Chapter 6 of the CCDP 2022-2028.

The use and application of the policies and guidelines constitutes the formal plan for flood risk management in County Carlow. This approach has been achieved in the development plan making process in the settlements contained within the plan and covered in this SFRA.

The specific management of risk is discussed for each settlement in Section 8.

6.1 Surface Water

Section 6.5 of the CDP outlines the approach to surface water management. CCC will require compliance with best practice guidance for the collection, reuse, treatment and disposal of surface waters for all future development proposals.

CCC seeks to ensure the sustainable management of surface water discharges through the use of Sustainable Urban Drainage Systems (SuDS). SuDS manage the water as close as possible to its origin replicating the natural characteristics of rainfall runoff from any site, ensuring water is infiltrated or conveyed more slowly to the drainage system and ultimately to water courses via permeable paving, swales, green roofs, rainwater harvesting, detention basins, ponds and wetlands. SuDS provides an integrated approach which addresses water quantity thereby reducing potential for flood risk, water quality, amenity and habitat.

CCC policy and objectives are outlined in the tables below.

Table 6-1 Surface Water & Groundwater (Incl. Sustainable Urban Drainage Systems) – Policies

Policy	Description
SG P1	Maintain and enhance the existing surface water drainage systems in Carlow-Graiguecullen and to protect surface and ground water quality in accordance with the Water Framework Directive.
SG P2	Require the use of Sustainable Urban Drainage Systems (SuDS) within development proposals and infrastructure projects, in accordance with the DHLGH Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas – Best Practice Interim Guidance Document, 2022' (and any subsequent amendments or revisions to the document), Carlow County Council's SuDS Policy, and Laois County Council's Storm Water Management Policy as appropriate, in order to reduce flood risk, improve water quality and enhance biodiversity and amenity in the joint urban area.
SW P3	Ensure that all development proposals maintain surface water discharge at greenfield run-off rate, including an allowance for climate change.

Table 6-2 Surface Water Objectives

Objective	Description
SG O1	Maintain, improve, and enhance the environmental and ecological quality of surface waters and groundwater in Carlow-Graiguecullen in conjunction with the Environmental Protection Agency (EPA) and in accordance with the River Basin Management Plan for Ireland 2018-2021 and any subsequent amendments or revisions to the Plan
SG 02	Require applicants, where necessary, to demonstrate that development proposals will not negatively impact on any surface water or groundwater body and be compliant with the requirements of the Water Framework Directive and measures to protect and improve our water bodies set down in the River Basin Management Plan for Ireland 2018 – 2021 and any subsequent amendments or revisions to the Plan.

6.2 Flood Risk Management

Section 6.10 of the CDP outlines the policy for the management of flooding. It highlights the context to the policy through an introduction to the EU Directive and national policy driven by the OPW's response to the Directive and the Planning Guidelines. CCC policy is outlined in the table below.

Table 6-3 Flood Management Policy

Policy	Description
FR P1	Ensure that all development proposals in Carlow- Graiguecullen comply with the requirements of the Planning System and Flood Risk Management: Guidelines for Planning Authorities (DEHLG and OPW, 2009) and Circular PL2/2014 (and any future revisions or updates to these Guidelines), in particular through the application of the sequential approach and the Development Management Justification Test.
FR P2	Have regard to the findings and recommendations of the Strategic Flood Risk Assessment (SFRA) carried out for this Joint Urban Local Area Plan.
FR P3	Carry out flood risk assessment for the purpose of regulating, restricting, and controlling development in areas at risk of flooding in Carlow-Graiguecullen and to minimise the level of flood risk to people, business, infrastructure and the environment through the identification and management of existing and potential future flood risk.
FR P4	Require the submission of a Site-Specific Flood Risk Assessment (FRA) in areas at risk of flooding in Carlow-Graiguecullen. The assessment shall be carried out by a suitably qualified and indemnified professional, shall be appropriate to the scale and nature of the risk to the proposed development and shall consider all sources of flooding. The FRA shall be prepared in accordance with the Planning System and Flood Risk Management: Guidelines for Planning Authorities (DEHLG and OPW, 2009) and Circular PL2/2014 (and any future revisions or updates to these Guidelines), and shall address climate change, residual risk, avoidance of contamination of water sources and any proposed site-specific flood management measures.
FR P5	Minimise flood risk arising from pluvial (surface water) flooding in Carlow-Graiguecullen by promoting the use of natural flood risk management measures including the use of Sustainable Urban Drainage Systems (SuDS) and nature-based solutions.
FR P6	Maintain a riparian (buffer) zone of not less than 10 metres between all watercourses and any development proposals to mitigate against flood risk, with the full extent of the buffer zone to be determined on a case-by-case basis by the Planning Authority, based on site specific characteristics and sensitivities and consultation with Inland Fisheries Ireland.

Table 6-4 Flood Risk Management Objectives

Policy	Description
FR O1	Manage flood risk in Carlow-Graiguecullen in conjunction with the Office of Public Works (OPW) and in accordance with the requirements of the Planning System and Flood Risk Management: Guidelines for Planning Authorities (2009), Circular PL02/2014, and any future revisions or updates to these Guidelines.
FR O2	Seek to ensure that where flood risk management works take place that the natural and cultural heritage of the River Barrow and Burren River is protected and improved where possible.

6.3 CFRAM Recommendations

Following the publication of the final Flood Risk Management Plans for the CFRAM Study in May 2018 a 10 year €1billion programme of works (for 118 schemes) was announced by the OPW.

The OPW's South Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study identified Carlow Town as an AFA. For Carlow the measure suggested was to maintain and upgrade the existing Carlow Flood Relief scheme.

The proposed management policy will maintain and upgrade several key flood protection benefits; reducing risk to numerous residential properties, an NIAH protected structure, 2 utilities, several social infrastructure assets and transport links for the current and future climate change scenarios. The Mill Race/Springfield area and the Knocknagee Stream in the Castle Oaks area were recommended by the CFRAM for new measures to combat currently undefended areas.

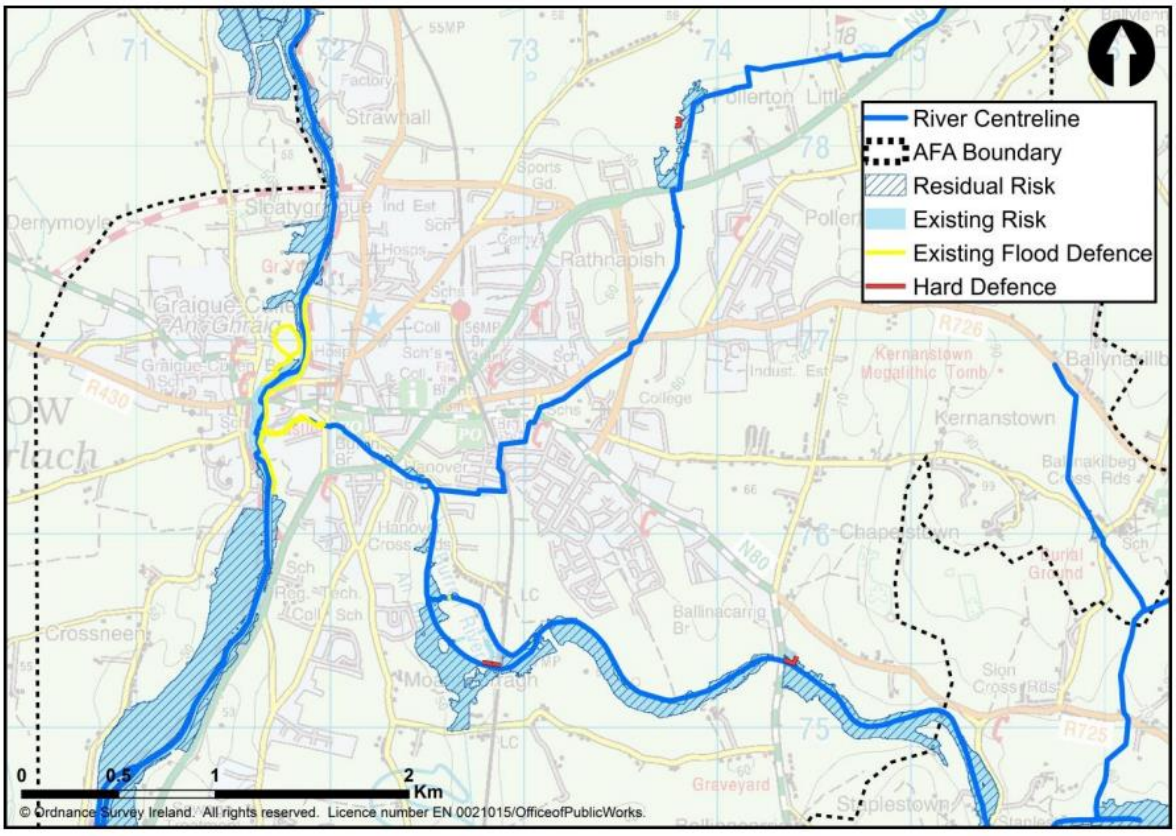


Figure 6-1 Carlow AFA CFRAM recommendation

7 Development Management and Flood Risk

In order to guide both applicants and relevant council staff through the process of planning for and mitigating flood risk, the key features of a range of development scenarios have been identified (relating the flood zone, development vulnerability and presence or absence of defences). For each scenario, a number of considerations relating to the suitability of the development are summarised below.

It should be noted that this section of the SFRA begins from the point that all land zoned for development has passed the Justification Test for Development Plans, and therefore passes Part 1 of the Justification Test for Development Management – which states that the land has in the first instance been zoned accordingly in a development plan (that underwent an SFRA). In addition to the general recommendations in the following sections, Section 8 should be reviewed for specific recommendations for individual settlements, including details of the application of the Justification Test. In areas where there are no formal land use zoning objectives, the Justification Test cannot pass for any sites within Flood Zone A/B. It would be down to a site-specific FRA to confirm (in appropriate detail) the extent of Flood Zone A/B.

In order to determine the appropriate design standards for a development it may be necessary to undertake a site-specific flood risk assessment. This may be a qualitative appraisal of risks, including drainage design. Alternatively, the findings of the CFRAM, or other detailed study, may be drawn upon to inform finished floor levels. In other circumstances a detailed modelling study and flood risk assessment may need to be undertaken. Further details of each of these scenarios, including considerations for the flood risk assessment are provided in the following sections.

7.1 Requirements for a Flood Risk Assessment

Assessment of flood risk is required in support of any planning application where flood risk may be an issue, and this may include sites in Flood Zone C (low probability of flooding) where a watercourse or field drain exists nearby. The level of detail will vary depending on the risks identified and the proposed land use. As a minimum, all proposed development, including that in Flood Zone C, must consider the impact of surface water flood risks on drainage design. In addition, flood risk from sources other than fluvial should be reviewed.

For sites within Flood Zone A or B (high/moderate probability of flooding), a site specific "Stage 2 - Initial FRA" will be required and may need to be developed into a "Stage 3 - Detailed FRA". The extents of Flood Zone A and B are delineated through this SFRA. However, future studies may refine the extents (either to reduce or enlarge them) so a comprehensive review of available data should be undertaken once an FRA has been triggered.

Within the FRA the impacts of climate change and residual risk (including culvert/structure blockage) should be considered and remodelled where necessary, using an appropriate level of detail, in the design of finished floor levels. Further information on the required content of the FRA is provided in the Planning System and Flood Risk Management Guidelines.

Any proposal that is considered acceptable in principle shall demonstrate the use of the sequential approach in terms of the site layout and design and, in satisfying the Justification Test (where required), the proposal will demonstrate that appropriate mitigation and management measures are put in place.

7.2 Drainage Design

All proposed development, whether in Flood Zone A, B or C, must consider the impact of surface water flood risks on drainage design as specified by the surface water management policies in the Greater Dublin Strategic Drainage Study (GDSDS) and this will be considered in the planning process. This may be in the form of a section within the flood risk assessment (for sites in Flood Zone A or B) or part of a surface water management plan.

Areas vulnerable to ponding are indicated on the OPW's PFRA mapping. Particular attention should be given to development in low-lying areas which may act as natural ponds for collection of run-off.

The drainage design should ensure no increase in flood risk to the site, or the downstream catchment. Where possible, and particularly in areas of new development, floor levels should at a minimum be 300mm above adjacent roads and hard standing areas to reduce the consequences

of any localised flooding. Where this is not possible, an alternative design appropriate to the location may be prepared.

In addition, for larger sites (i.e. multiple dwellings or commercial units) master planning should ensure that existing flow routes are maintained, through the use of green infrastructure.

7.3 Development in Flood Zones A or B

7.3.1 Minor Developments

Section 5.28 of the Planning Guidelines on Flood Risk Management identifies certain types of development as being 'minor works'. In such cases, the sequential approach cannot be used to locate such development in lower-risk areas and the Justification Test will not apply.

Generally, the approach to deal with flood protection would involve raising the ground floor levels above extreme flood levels. However, in some parts of the plan area, which are already developed, ground floor levels for flood protection could lead to floor levels being much higher than adjacent streets, thus creating a hostile streetscape for pedestrians. This would cause problems for infill development sites if floor levels were required to be significantly higher than those of neighbouring properties. In this regard, for the key sites in the plan area it has been recognised that ground floor levels below predicted flood levels could be allowed, in limited circumstances, on a site by site basis, for commercial and business developments. However, if this is the case, then these would be required to be flood resistant construction using water resistant materials and electrical fittings places at higher levels. For high risk areas it would also be necessary to impose planning restrictions in these areas. Residential Uses would not be permitted at ground flood levels in high risk zones.

It should be noted that for residential buildings within Flood Zone A or B, bedroom accommodation shall not be permitted at basement or ground floor.

For commercial operations, business continuity must be considered, and steps taken to ensure operability during and recovery after a flood event for both residential and commercial developments. Emergency access must be considered as in many cases flood resilience will not be easily achieved in the existing build environment.

The requirement for providing compensatory storage for minor developments has been reviewed and can generally be relaxed, even where finished floor levels have been raised, and particularly where flood risk is primarily tidal or the development is behind defences. This is because the development concerns land which has previously been developed and would already have limited capacity to mitigate flooding and would particularly be the case in tidal risk areas. However, a commentary to this effect must be substantiated in the FRA and should be discussed with Carlow County Council prior to submission of a planning application.

7.3.2 Highly vulnerable development in Flood Zone A or B

Development which is highly vulnerable to flooding, as defined in The Planning System and Flood Risk Management, includes (but is not limited to) dwelling houses, hospitals, emergency services and caravan parks.

New development

It is not appropriate for new, highly vulnerable, development to be located in Flood Zones A or B outside the core of a settlement. Such proposals do not pass the Justification Test for Development Plans. Instead, a less vulnerable or water compatible use should be considered.

In some cases, land use objectives which include for highly vulnerable uses have been justified in the Development Plan. This includes zonings focused around an urban core which allow for a mix of residential, commercial and other uses. In such cases, a sequential approach to land use within the site must be taken and will consider the presence or absence of defences, land raising and provision of compensatory storage, safe access and egress in a flood and the impact on the wider development area.

Existing developed areas

The Planning Circular (PL02/2014) states that "*notwithstanding the need for future development to avoid areas at risk of flooding, it is recognised that the existing urban structure of the country contains many well established cities and urban centres which will continue to be at risk of flooding. In addition, development plans have identified various strategically important urban centres … whose continued consolidation, growth, development or generation, including for residential use, is being encouraged to bring about compact and sustainable growth*.

In cases where specific development proposals have passed the Justification Test for Development Plans, the outline requirements for a flood risk assessment and flood management measures are detailed in this SFRA in the following sections and the site specific assessments in Section 8, which also detail where such development has been justified. Of prime importance is the requirement to manage risk to the development site and not to increase flood risk elsewhere. It should also be noted that for residential buildings within Flood Zone A or B, bedroom accommodation shall not be permitted at basement or ground floor.

7.3.3 Less vulnerable development in Flood Zone A or B

This section applies to less vulnerable development in Flood Zone A which has passed the Justification Test for development plans, and less vulnerable development in Flood Zone B, where this form of development is appropriate, and the Justification Test is not required. Development which is less vulnerable to flooding, as defined in The Planning Guidelines, includes (but is not limited to) retail, leisure and warehousing and buildings used for agriculture and forestry (see Table 3-3 for further information). This category includes less vulnerable development in all forms, including refurbishment or infill development, and new development both in defended and undefended situations.

The design and assessment of less vulnerable development should begin with 1% AEP fluvial or 0.5% tidal events (depending on dominant flood source) as standard, with climate change and a suitable freeboard included in the setting of finished floor levels. The presence or absence of flood defences informs the level of flood mitigation recommended for less vulnerable developments in areas at risk of flooding. In contrast with highly vulnerable development, there is greater scope for the developer of less vulnerable uses to accept flood risks and build to a lower standard of protection, which is still high enough to manage risks for the development in question. However, any deviation from the design standard of 1%/0.5% AEP, plus climate change, plus freeboard, needs to be fully justified within the FRA and show an appropriate response to the flood risk present and to be agreed with Carlow County Council engineers and planners. However, in County Carlow there are limited locations where formal (non-agricultural) flood defences are present.

7.4 Development in Flood Zone C

Where a site is within Flood Zone C but adjoining or in close proximity of a watercourse, there could be a risk of flooding associated with factors such as future scenarios (climate change), blocking of a bridge or culvert or other residual risk. Risk from sources other than fluvial and coastal must also be addressed for all development in Flood Zone C, including groundwater flooding and/or flooding associated with stormwater deficiencies, restrictions or blockages. As a minimum in such a scenario, an assessment of flood risk should be undertaken which will screen out possible sources of flood risk and where they cannot be screened out it should present mitigation measures. The most likely mitigation measure will involve setting finished floor levels to a height that is above the 1% AEP fluvial event level, with an allowance for climate change and freeboard, or to ensure a step up from road level to prevent surface water ingress. Design elements such as channel maintenance or trash screens may also be required. Evacuation routes in the event of inundation of surrounding land should also be detailed.

Guidance for the assessment of surface water risk is provided in Section 7.6.

The impacts of climate change should be considered for all proposed developments. A development which is currently in Flood Zone C may be shown to be at risk when an allowance for climate change is applied. Details of the approach to incorporating climate change impacts into the assessment and design are provided in Section 7.8.

7.5 Water compatible uses in Flood Zone A or B

Water compatible uses can include the non-built environment, such as open space, agriculture and green corridors which are appropriate for Flood Zone A and B and are unlikely to require a flood risk assessment. However, there are numerous other uses which are classified as water compatible, but which involve some kind of built development, such as lifeguard stations, fish processing plants and other activities requiring a waterside location. In other situations, works to an area of open space may result in changes to the topography which could lead to loss in flood plain storage and/or impacts on flood conveyance. The Justification Tests are not required for such development, but an appropriately detailed flood risk assessment is required. This should consider mitigation measures such as development layout and finished floor levels, access, egress and emergency plans. In line with other highly vulnerable development, sleeping accommodation at basement or ground floor level will not be permitted. Climate change and other residual risks should also be considered within the SSFRA.

7.6 Drainage Impact Assessment

All proposed development, including that in Flood Zone C, must consider the impact of surface water flood risks on drainage design.

There are extensive networks of surface water runoff routes across the settlement, with areas vulnerable to ponding indicated on the Flood Zone Maps. Particular attention should be given to development in low-lying areas which may act as natural ponds for collection of runoff. The council are currently undertaking a review of the surface water systems and the results of this assessment should inform site drainage design as they are available.

The drainage design shall ensure no increase in flood risk to the site, or the downstream catchment. Reference should be made to the relevant policies in the Development Plan and any forthcoming Surface Water Strategy for details of the assessment process.

Master planning of development sites should ensure that existing flow routes are maintained, through the use of green infrastructure. Where possible, and particularly in areas of new development, floor levels should at a minimum be 300mm above adjacent roads and hard standing areas to reduce the consequences of any localised flooding. Where this is not possible, an alternative design appropriate to the location may be prepared.

7.7 Requirements for a Flood Risk Assessment

An appropriately detailed flood risk assessment will be required in support of all planning applications. The level of detail will vary depending on the risks identified and the proposed land use. As a minimum, all proposed development, including that in Flood Zone C, must consider the impact of surface water flood risks on drainage design. In addition, flood risk from sources other than fluvial and tidal should be reviewed.

For sites within Flood Zone A or B, a site specific "Stage 2 - Initial FRA" will be required and subject to the outcome may need to be developed into a "Stage 3 - Detailed FRA". The extents of Flood Zone A and B are delineated through this SFRA. However, future studies may refine the extents (either to reduce or enlarge them) and proposed variations to the Flood Zones should be discussed with Carlow County Council.

An assessment of the risks of flooding should accompany applications to demonstrate that they would not have adverse impacts or impede access to a watercourse, floodplain or flood protection and management facilities, particularly for operation and maintenance activities by Carlow County Council and OPW. Where possible, the design of built elements in these applications should demonstrate principles of flood resilient design (See Section 4 - Designing for Residual Flood Risk of the Technical Appendices to the DoECLG Flooding Guidelines). Emergency access must be considered, as in many cases flood resistance (such as raised finished floor levels and flood barriers) and retrofitting flood resilience features may be challenging in an existing building. Within the FRA the impacts of climate change and residual risk (including culvert/structure blockage) should be considered and remodelled where necessary, using an appropriate level of detail, in the design of FFL. Further information on the required content of the FRA is provided in the Planning Guidelines.

Any proposal that is considered acceptable in principle shall demonstrate the use of the sequential approach in terms of the site layout and design and, in satisfying the Justification Test

for Development Management (where required), the proposal will demonstrate that appropriate mitigation and management measures are put in place.

7.7.1 Development in Defended Areas

Carlow is partially defended and in this case it should be noted that where a site or area is referred to as being defended for the purposes of determining flood mitigation it is assumed that the defences provide a minimum of the 1% AEP (fluvial) or 0.5% AEP (tidal) standard of protection, and have been through a formal detailed design process and approved by OPW or Carlow County Council. Informal defences, which may only be at an agricultural standard, or those developed under the minor works scheme which may provide a lesser standard of protection, are not considered to provide a robust enough standard of protection to allow a moderation in the flood risk mitigation required at a site. The understanding of risks of developing behind defences needs to be explored in the site specific FRA and this has been discussed in detail under the Justification tests presented in Appendix A.

7.7.2 Checklist for Applications for Development in Areas at Risk of Flooding

This section applies to both highly and less vulnerable development in Flood Zone A and highly vulnerable development in Flood Zone B that satisfy the following:

- Meet the definition of Minor Development; or
- Have passed the Justification Test for Development Plans and be able to pass the Justification Test for Development Management to the satisfaction of the Planning Authority.
- The following checklist is required for all development proposals:
- The SSFRA be carried out by an appropriately qualified Engineer with relevant FRA experience (as deemed acceptable by the Planning Authority), in accordance with the Carlow County Council SFRA and the Planning Guidelines.
- Demonstration that the specific objectives or requirements for managing flood risk set out in Section 8 of this SFRA have been complied with, including an assessment of residual risks.
- Preparation of access, egress and emergency plans which are appropriate to the source of flooding and lead time to issue a warning, vulnerability of the development and its occupiers, the intensity of use and the level of flood risk.
- An assessment of the potential impacts of climate change and the adaptive capacity of the development.
- Compliance with C753 CIRIA SUDS guide, GDSDS and inclusion of SuDS.

7.8 Climate Change

In all developments, climate change should be considered when assessing flood risk and in particular residual flood risk. Climate change may result in increased flood extents and therefore caution should be taken when zoning lands in transitional areas (i.e. on the edge of the floodplain). Consideration of climate change is particularly important where flood alleviation measures are proposed, as the design standard of the proposal may reduce significantly in future years due to increased rainfall and river flows (sea levels are not a pertinent consideration in Carlow).

The 'Planning System and Flood Risk Management' recommends that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. A significant amount of research into climate change has been undertaken on both a national and international front, and updates are ongoing.

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 Climate Change Sectoral Adaptation Plan. 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 the table below. These climate change allowances are particularly important at the development management

stage of planning and will ensure that proposed development is designed and constructed to take into account best current knowledge.

Table 7-1: Allowances for Future Scenarios (100-year Time Horizon)

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

Notes:

* Applicable to the southern part of the country only (Dublin - Galway and south of this)

** Reduce the time to peak (Tp) by a third; this allows for potential accelerated runoff that may arise as a result of drainage of afforested land.

*** Add 10% to the Standard Percentage Runoff (SPR) rate; this allows for increased runoff rates that may arise following felling of forestry

Through the CFRAM Study, both MRFS and HEFS model runs have been completed on all study watercourses, providing flood extent and depth maps. This information can be used to support flood risk assessments.

For watercourses that are not part of the CFRAM programme, fluvial flood extents can be qualitatively assessed by using the Flood Zone B outline as a surrogate for 'Flood Zone A with allowance for the possible impacts of climate change', as suggested in the 'Planning System and Flood Risk Management'. Quantitative assessment of risks may require an additional model run to fully understand risks.

For most development, including residential, nursing homes, shops and offices, the medium-range future scenario (20% increase in flows) is an appropriate consideration. This should be applied in all areas that are at risk of flooding (i.e. within Flood Zone A and B) and should be considered for sites which are in Flood Zone C but are adjacent to Flood Zone A or B. This is because land which is currently not at risk may become vulnerable to flooding when climate change is taken into account.

Where the risk associated with inundation of a development is low and the design life of the development is short (typically less than 30 years) the allowance provided for climate change may be less than the 20% / 0.5m level. However, the reasoning and impacts of such an approach should be provided in the site-specific FRA.

Conversely, there may be development which requires a higher-level response to climate change. This could include major facilities which are extremely difficult to relocate, such as hospitals, airports, Seveso sites or power stations, and those which represent a high-economic and long-term investment within the scale of development across the county. In such situations it would be reasonable to expect the high-end future scenario (30% increase in flow) to be investigated in the site-specific FRA and used as the design standard.

In general, climate change will be accounted for the setting of finished floor levels to a height which includes an allowance for climate change. However, climate change may also reveal additional flow paths which need to be protected or give rise to flows which exceed culvert capacity or overtop defences. These outcomes will need to be specifically investigated for each site, and an appropriate response provided.

Further consideration to the potential future impacts of climate change is given for each settlement in Section 8.

7.9 Flood Mitigation Measures at Site Design

For any development proposal in an area at moderate or high risk of flooding that is considered acceptable in principle (i.e. has passed the Plan Making Justification Test), the site-specific FRA must demonstrate that appropriate mitigation measures can be put in place and that residual risks can be managed to acceptable levels. This may include the use of flood-resistant construction measures that are aimed at preventing water from entering a building and that mitigate the damage floodwater causes to buildings. Alternatively, designs for flood resilient construction may be adopted where it can be demonstrated that entry of floodwater into buildings is preferable to limit damage caused by floodwater and allow relatively quick recovery.

Various mitigation measures are outlined below and further detail on flood resilience and flood resistance are included in the Technical Appendices of the Planning Guidelines, The Planning System and Flood Risk Management.

7.9.1 Site Layout and Design

To address flood risk in the design of new development, a risk-based approach should be adopted to locate more vulnerable land use to higher ground while water compatible development i.e. car parking (with appropriate flood management plan) and recreational space can be located in higher flood risk areas.

The site layout should identify and protect land required for current and future flood risk management. Waterside areas or areas along known flow routes can be used for recreation, amenity and environmental purposes to allow preservation of flow routes and flood storage, while at the same time providing valuable social and environmental benefits.

7.9.2 Ground Levels, Floor Levels and Building Use

Modifying ground levels to raise land above the design flood level is a very effective way of reducing flood risk to the site. However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced locally and could increase flood risk off site. There are a number of criteria which must all be met before this is considered a valid approach:

- Development at the site must have been justified through this SFRA based on the existing (unmodified) ground levels.
- The FRA should establish the function provided by the floodplain. Where conveyance is a prime function then a hydraulic model will be required to show the impact of its alteration.
- The land being given over to storage must be land which does not flood in the 1% AEP fluvial event (i.e. Flood Zone B or C).
- Compensatory storage should be provided on a level for level basis to balance the total area that will be lost through infilling where the floodplain provides static storage.
- The provision of the compensatory storage should be in close proximity to the area that storage is being lost from (i.e. within the same flood cell).
- The land proposed to provide the compensatory storage area must be within the ownership / control of the developer.
- The compensatory storage area should be constructed before land is raised to facilitate development.
- Compensatory storage is generally not required for loss of floodplain in locations behind defences.

In some sites it is possible that ground levels can be re-landscaped to provide a sufficiently large development footprint. However, it is likely that in other potential development locations there is insufficient land available to fully compensate for the loss of floodplain. In such cases it will be necessary to reconsider the layout or reduce the scale of development or propose an alternative and less vulnerable type of development. In other cases, it is possible that the lack of availability of suitable areas of compensatory storage mean the target site cannot be developed and should remain open space.

Raising finished floor levels within a development is an effective way of avoiding damage to the interior of buildings (i.e. furniture and fittings) in times of flood. Alternatively, assigning a water compatible use (i.e. garage / car parking) or less vulnerable use to the ground floor level, along with suitable flood resilient construction, is an effective way of raising vulnerable living space

above design flood levels. It can however have an impact on the streetscape. Safe access and egress is a critical consideration in allocating ground floor uses.

Depending on the scale of residual risk, resilient and resistance measures may be an appropriate response, but this will mostly apply to less vulnerable development.

7.9.3 Raised Defences

Construction of raised defences (i.e. flood walls and embankments) has traditionally been the response to flood risk. However, this is not a preferred option on an ad-hoc basis where the defences to protect the development are not part of a strategically led flood relief scheme. Where a defence scheme is proposed as the means of providing flood defence, the impact of the scheme on flood risk up and downstream must be assessed and appropriate compensatory storage must be provided.

7.9.4 Emergency Flood Response Plan

In some instances, and only when all parts both the Plan Making and Development Management Justification Tests have been passed, it may be necessary for an emergency flood response plan to be prepared to support other flood management measures within the context of a less vulnerable or water compatible development. An emergency response plan may be required to trigger the operation of demountable flood defences to a less vulnerable development, evacuation of a car park or closure of a business or retail premises.

The emergency plan will need to detail triggers for activation, including receipt of a timely flood warning, a staged response and to set out the management and operational roles and responsibilities. The plan will also need to set out arrangements for access and egress, both for pedestrians, vehicles and emergency services. The details of the plan should be based on an appropriately detailed assessment of flood risk, including speed of onset of flooding, depths and duration of inundation.

However, just because it is possible to prepare an emergency plan does not mean this is advisable or appropriate for the nature and vulnerability of development.

7.9.5 Nature based solutions / Green Infrastructure / SUDS

Measures can be taken that aim to retain water on the landscape during periods of high rainfall and flood by mimicking the functioning of a natural landscape, thereby reducing the magnitude of flood events and providing complementary ecosystem services. In general, nature-based measures aim to:

- Reduce the rate of runoff during periods of high rainfall;
- Provide flood storage in upper catchment areas; and
- Use natural materials and “soft” engineering techniques to manage flooding in place of “hard” engineering in river corridors.

Nature-based measures to control flooding typically focus on the use of porous surfaces in developments (Sustainable Urban Drainage Systems or SUDS), planting of native vegetation communities/assemblages that are tolerant of both wet and dry conditions and reversing the impacts of over-engineered river corridors (river restoration) to reduce the peak of flood events by mimicking the function of a natural catchment landscape. In addition to providing flood relief benefits, nature-based solutions can provide an array of ecosystem services including silt and pollution control for runoff entering the river system, improved riparian and in-river habitats, localised temperature reduction during periods of extreme heat, reduced maintenance requirements in engineered systems, groundwater recharge, and carbon sequestration.

These measures can be implemented across an array of scales, for instance across a catchment as part of a wider flood relief scheme, or on a site-specific basis as part of a landscaping or green infrastructure plan. Nature-based solutions can provide flood mitigation benefits and ecosystem services across all scales if given adequate planning and should be considered during the site layout and design stages of a development. The Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas – Best Practice Interim Guidance Document (2022) provides guidance in making appropriate planning and design decisions to incorporate nature based solutions and climate change adaptation to urban spatial planning.

The drainage design shall ensure no increase in flood risk to the site, or the downstream catchment. Reference should be made to the CCDP and Carlow Graiguecullen JULAP for further policy and objectives. Considerable detail on the process and design of SuDS is also provided in C753, the Dublin SuDS Manual and the Greater Dublin Strategic Drainage Study.

7.9.6 Green Corridor

It is recommended that, where possible, and particularly where there is greenfield land adjacent to the river, a 'green corridor', is retained on all rivers and streams. This will have a number of benefits, including:

- Retention of all, or some, of the natural floodplain;
- Potential opportunities for amenity, including riverside walks and public open spaces;
- Maintenance of the connectivity between the river and its floodplain, encouraging the development of a full range of habitats;
- Natural attenuation of flows will help ensure no increase in flood risk downstream;
- Allows access to the river for maintenance works;
- Retention of clearly demarcated areas where development is not appropriate on flood risk grounds, and in accordance with the Planning System and Flood Risk Management.

The width of this corridor should be determined by the available land, and topographically constraints, such as raised land and flood defences, but would ideally span the fully width of the floodplain (i.e. all of Flood Zone A).

8 Settlement Zoning Review

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

This section of the SFRA will:

- Outline the strategic approach to flood risk management.
- Consider the land use zoning objectives utilised within Carlow and assess their potential vulnerability to flooding.
- Based on the associated vulnerability of the particular use, a clarification on the requirement of the application of the Justification Test is provided.
- The consideration of the specific land use zoning objectives and flood risk will be presented for the settlements. Comment will be provided on the use of the sequential approach and justification test. Conclusions will be drawn on how flood risk is proposed to be managed in the settlement.

8.1 A Strategic Approach to Flood Risk Management

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

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

It is important to note that whilst it may be technically feasible to mitigate or manage flood risk at site level, strategically it may not be a sustainable approach.

A summary of flood risks associated with each of the zoning objectives has been provided in the following settlement reviews. The Flood Risk commentary indicates whether a certain land zoning, in Flood Zone A or B, will need to have the Plan Making Justification Test (JT) applied and passed.

When carrying out a site-specific FRA, or when planning applications are being considered, it is important to remember that not all uses will be appropriate on flood risk grounds, hence the need to work through the Justification Test for Development Management on a site by site. For example, a Town Centre zoning objective can include for an integrated mix of residential, commercial, community and social uses which have varying vulnerabilities and would not be equally permissible within Flood Zone A and B.

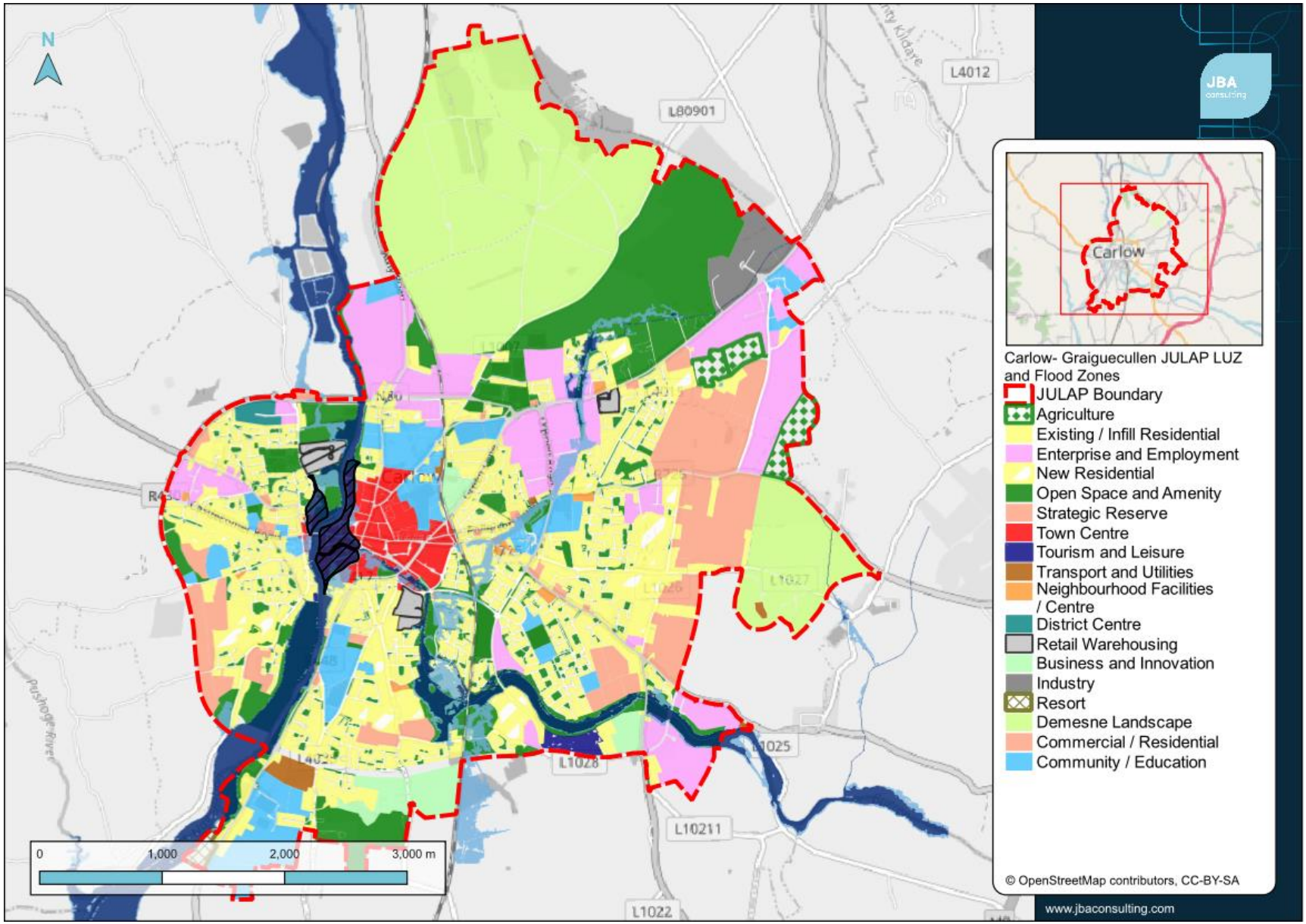
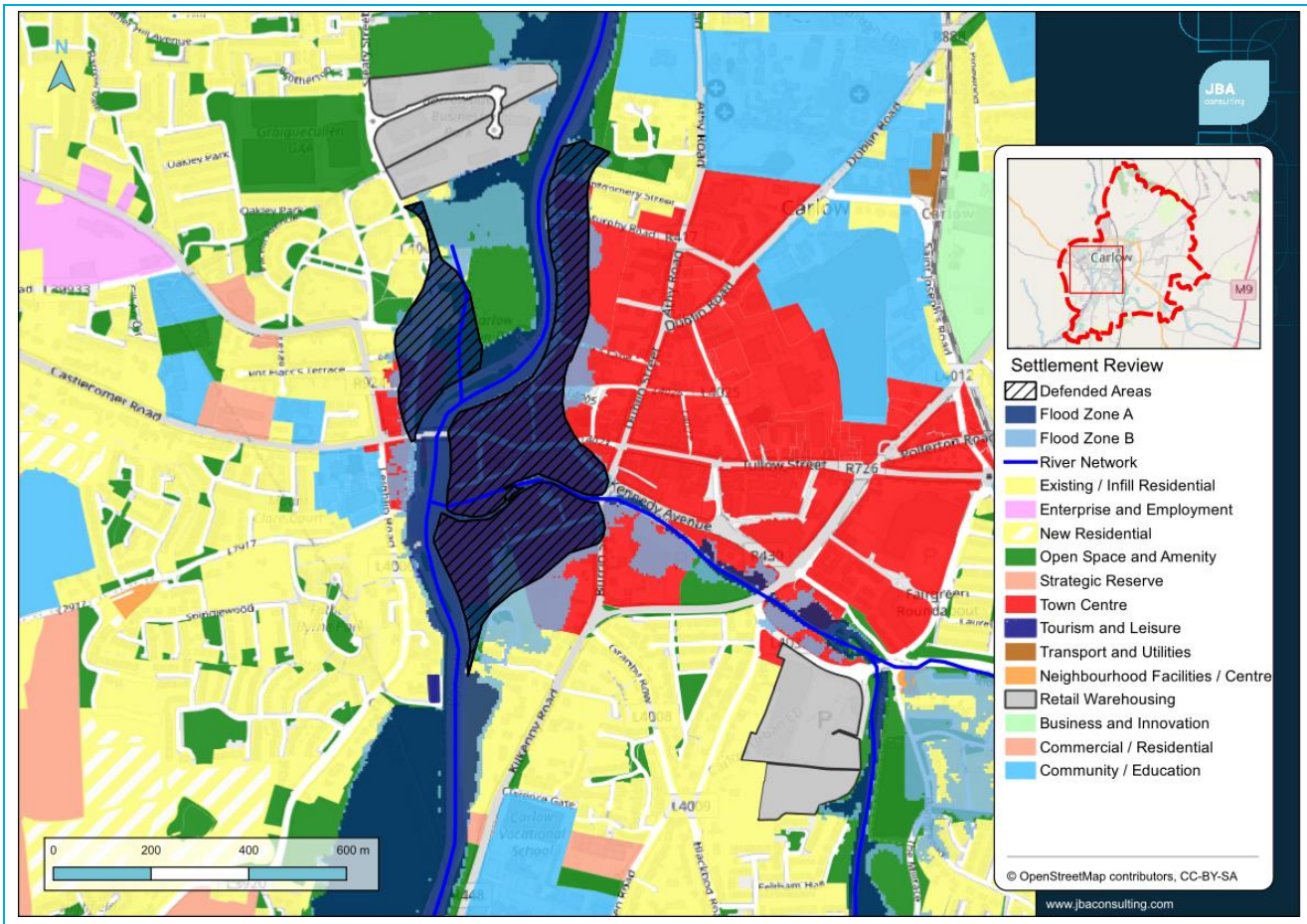


Figure 8-1 Carlow-Graiguecullen JULAP with flood zones

The following sections review the land use zoning objectives for each settlement area within the plan and provide a comprehensive summary of flood risk and justification where necessary.

8.2 Town Centre



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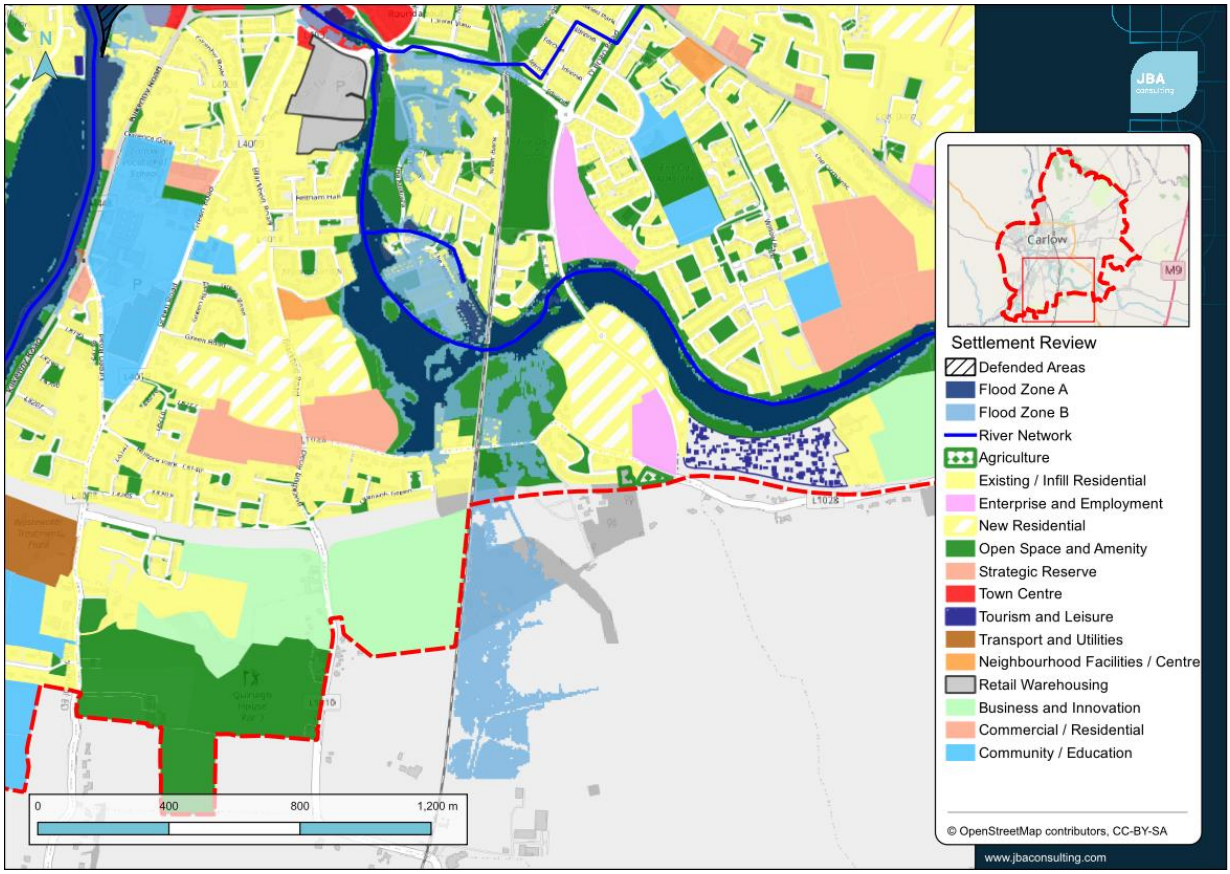
The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity. Areas that benefit from defences are annotated separately.

Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	Carlow is subject to an existing flood relief scheme which protects significant areas of Town Centre zoning from the River Barrow. Defences (retaining walls) were constructed along the River Barrow and Burrin River. This scheme defends Carlow town centre up to, and including, the 1% AEP event.
Historic Flooding	Several areas of Carlow Town have flooded in the past but a relief scheme now protects central areas of the town.
Comment	Defended Flood Zone A and areas of Flood Zone B impact Town Centre, Existing/Infill Residential, Residential, Retail Warehousing, and Open Space and Amenity.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	The town centre area is subject to regeneration plans which are formalised under the Carlow 2040 masterplan and allow consolidation of development, the Justification Test has been applied and passed. These areas include the former Celtic Linen Site and the Pembroke District. For both sites it is a suitable opportunity to apply nature based surface water management in line with SG P2 and the DHLGH Best Practice Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Both sites are protected by the Carlow FRS and future development in these

	areas can develop within the defended Flood Zone A and Flood Zone B. Due to the presence of the defences ground levels can be raised appropriately to achieve the design FFL for the type of development proposed, without the need for compensatory storage. All development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and within Appendix A.1.1 and A.1.2, development must specifically address the following: • The Masterplan should be subject to an appropriately detailed FRA that finalises the design flood levels and mitigation approach; • The FRA should address climate change scenarios in relation to FFLs; • Basement levels are permitted, but no highly vulnerable development would be permitted on this level and the access point to the basement and any vents/opes should be above the design flood level including freeboard; • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Other defended areas of the Town Centre are managed in a similar way and this is set out in Appendix A.1.3. Elsewhere in the Town Centre there are existing developed lands (principally residential), some of which do not benefit from the flood defences, where this is the case there are restrictions placed on new development in order to apply and pass the Justification Test. This is defined further under Appendix A.1.4, and is on the basis that within areas not benefitting from the FRS (undefended) development is; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and the further measures outlined under Appendix A.1.5. Where there is also some undefended residential zoned land (Barrowville) a similar approach has been applied and this is detailed under Appendix A.1.5. The Retail Warehousing lands adjacent to the Burrin River are also at potential risk and are undefended but are a lower vulnerability class. Any future planning applications for extensions/refits/change of use should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and the guidance provided under Appendix A.1.6.

8.3 Mill Race/Springfield Area

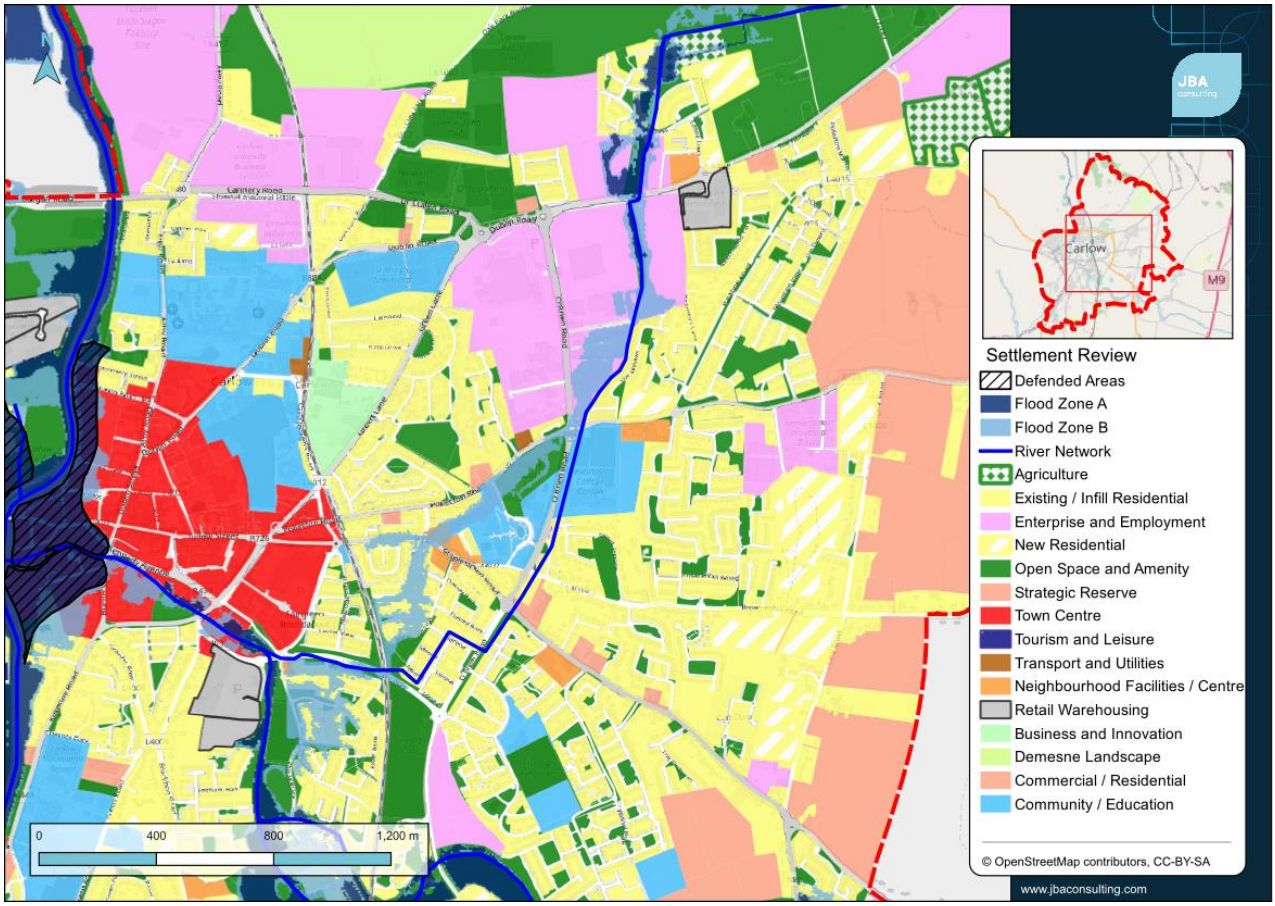


The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity. Areas that benefit from defences are annotated separately.

Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	None present in this area.
Historic Flooding	Burrin Paupish Lane has reported to flood in the past.
Comment	Much of the risk is limited to existing developments and open space. There is fluvial risk to Existing Residential/Infill, Neighbourhood Facilities/Centre, and Open Space. The Justification test has been applied and passed for those parts of Existing Residential/Infill adjacent to the core and Neighbourhood Facilities/Centre.
Climate Change	Moderate sensitivity to climate change in the south of the area. Care should be taken here in the area zoned for Business and Innovation.
Conclusion	The Justification Test for Existing Residential (see Appendix A.2.1) is passed on the basis that development is: • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • There are to be no bedrooms on the ground floor when extending existing residential property in Flood Zone A/B. Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the points detailed in Part 3 of the JT under Appendix A.2.1. The Justification Test was also applied for Neighbourhood Facilities/Centre Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning (see Appendix A.2.2):

	Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach should be applied and built development should preferably be located in Flood Zone C; • Flood Zone A would principally be suitable for playing pitches/water compatible use only; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy. Elsewhere in the area, risk can be managed in line with CCC approved policy and the guidance provided within Section 7 of this SFRA.

8.4 Knockane Stream downstream of Castle Oaks



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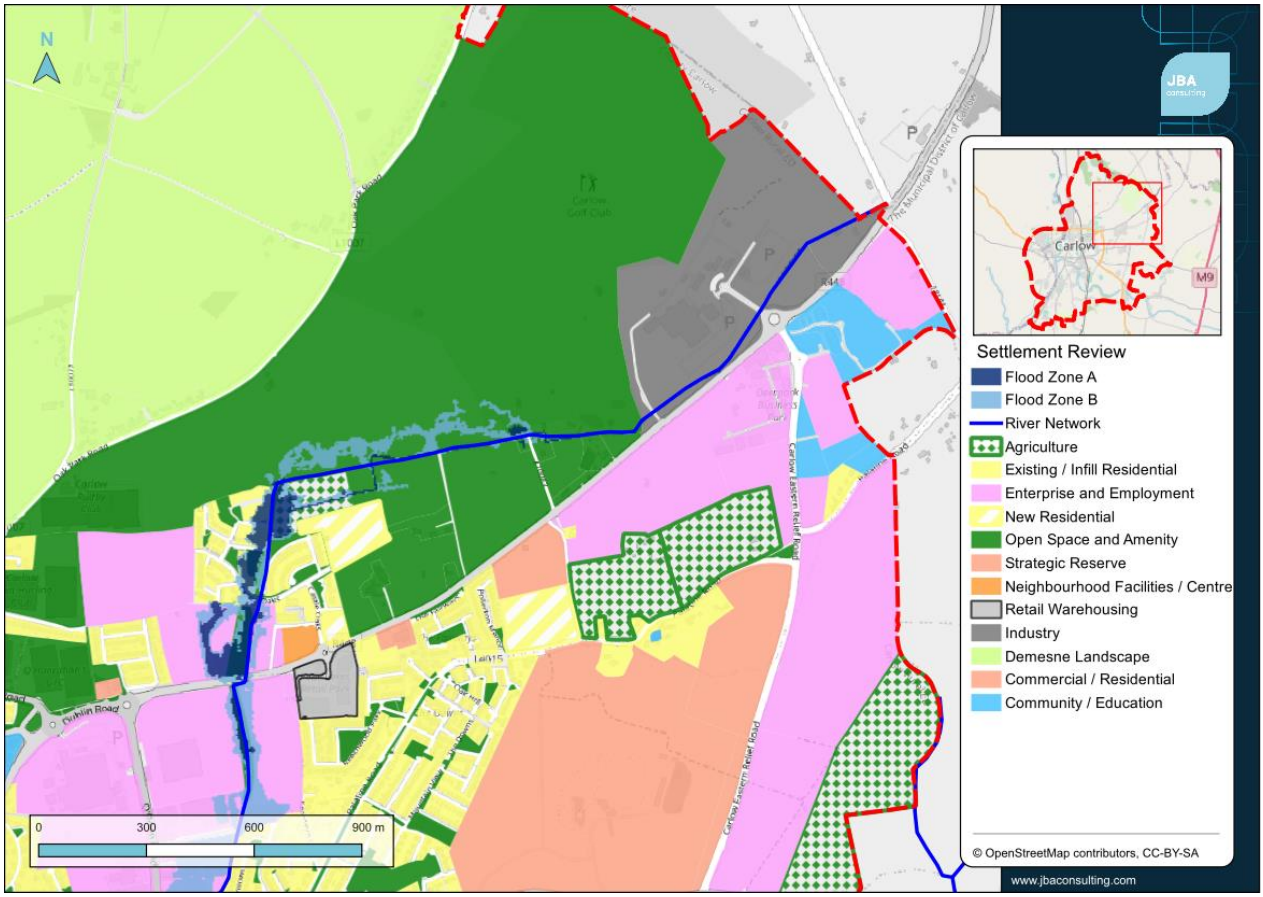
The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity. Areas that benefit from defences are annotated separately.

Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	No flood risk scheme present.
Historic Flooding	There has been reports of recurring flooding here at Askagh drive.
Comment	There is a risk of flooding along the Knocknagee Stream during a 1 in 1000 year event. Flooding is due to the Knocknagee Stream entering a culvert which surcharges at the 0.1% AEP. Risk is limited to Existing/Infill Residential, Community/Education, Neighbourhood Facilities/Centre, Commercial/Residential and Open Space and Amenity.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	Most of the risk is to existing developments and since the area is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For Existing/Infill Residential development must be; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • There are to be no bedrooms on the ground floor. • Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA.

	For Community/Education any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach should be applied and built development should preferably be located in Flood Zone C; • Flood Zone A would principally be suitable for water compatible use only; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy. For Commercial/Residential any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • Any development shall also be required to be built in accordance with CCC SuDS Policy. • The sequential approach should be applied and Highly vulnerable elements of the site should be located in Flood Zone C, or appropriately mitigated; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. For Neighbourhood Facilities/Centre, any future development of the site should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • A Change of use to residential/high vulnerability use would not be appropriate at this location. • FRA should consider flood resistance and resilience measures for any less vulnerable development; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy. Elsewhere in the area, risk can be managed in line with CCC approved policy and the guidance provided within Section 7 of this SFRA.

8.5 Knockane Stream Castle Oaks



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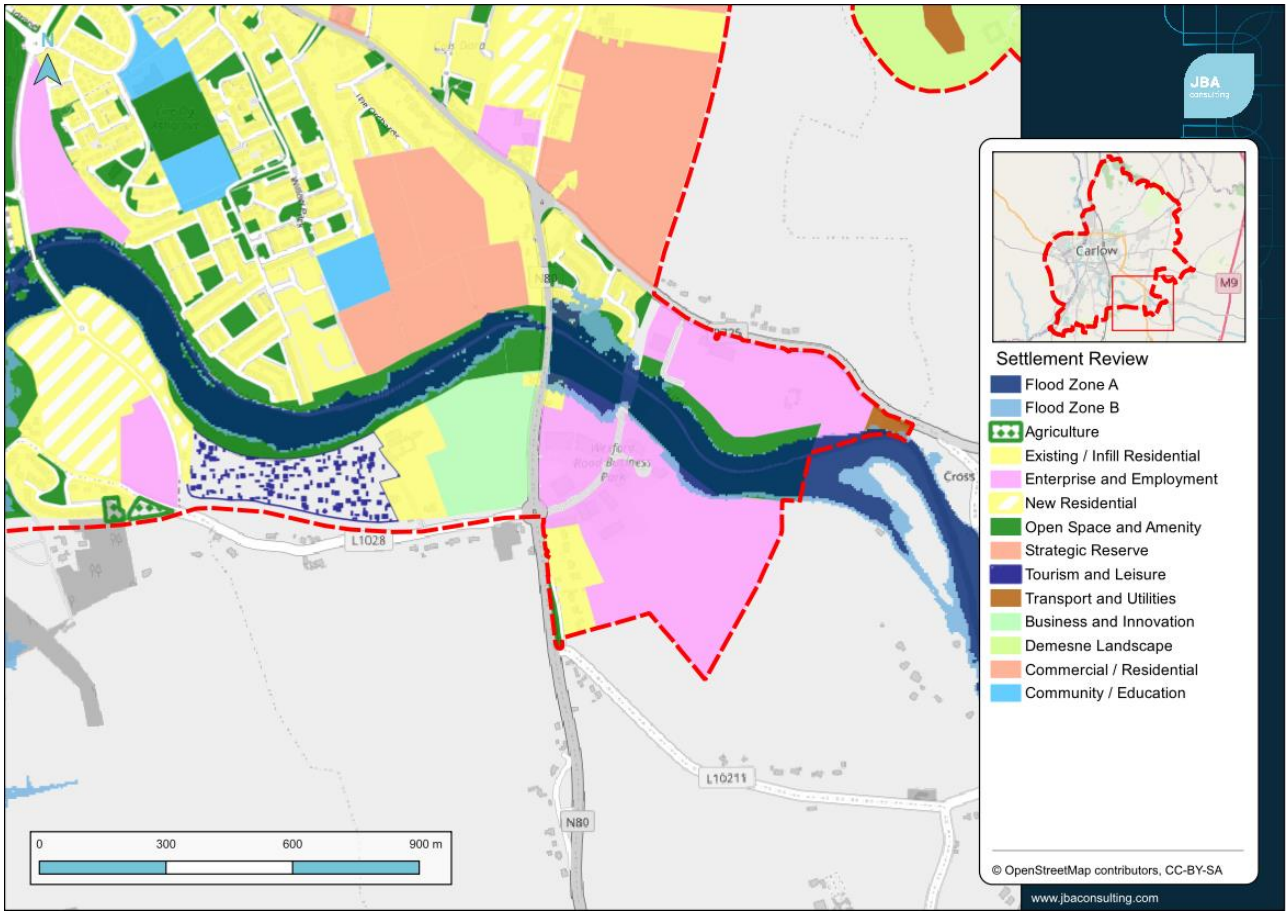
The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity. Areas that benefit from defences are annotated separately.

Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	None present in this area.
Historic Flooding	Area has historically flooded at Pollerton Big, Dr. Cullen Road, and areas along the Knockane Stream.
Comment	Risk of flooding is present in areas and along the banks of the Knockane stream. Risk is limited to Existing/Infill Residential, Enterprise and Employment, Agriculture and Open Space and Recreation.
Climate Change	Moderate sensitivity to climate change in area to the north of the Knockane stream.
Conclusion	Since the area is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For the Enterprise and Employment lands any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach must be applied, and less vulnerable elements of the site should be located in Flood Zone B or preferably C; • Highly vulnerable development would only be suitable in Flood Zone C. • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Any development shall also be required to be built in accordance with

	CCC SuDS Policy. For Existing Residential development must be; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • There are to be no bedrooms on the ground floor. • Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA. For Agriculture use then no less vulnerable development is appropriate within Flood Zone A. For other sites within the area risk must be managed in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.6 Burrin River south of Tullow Road



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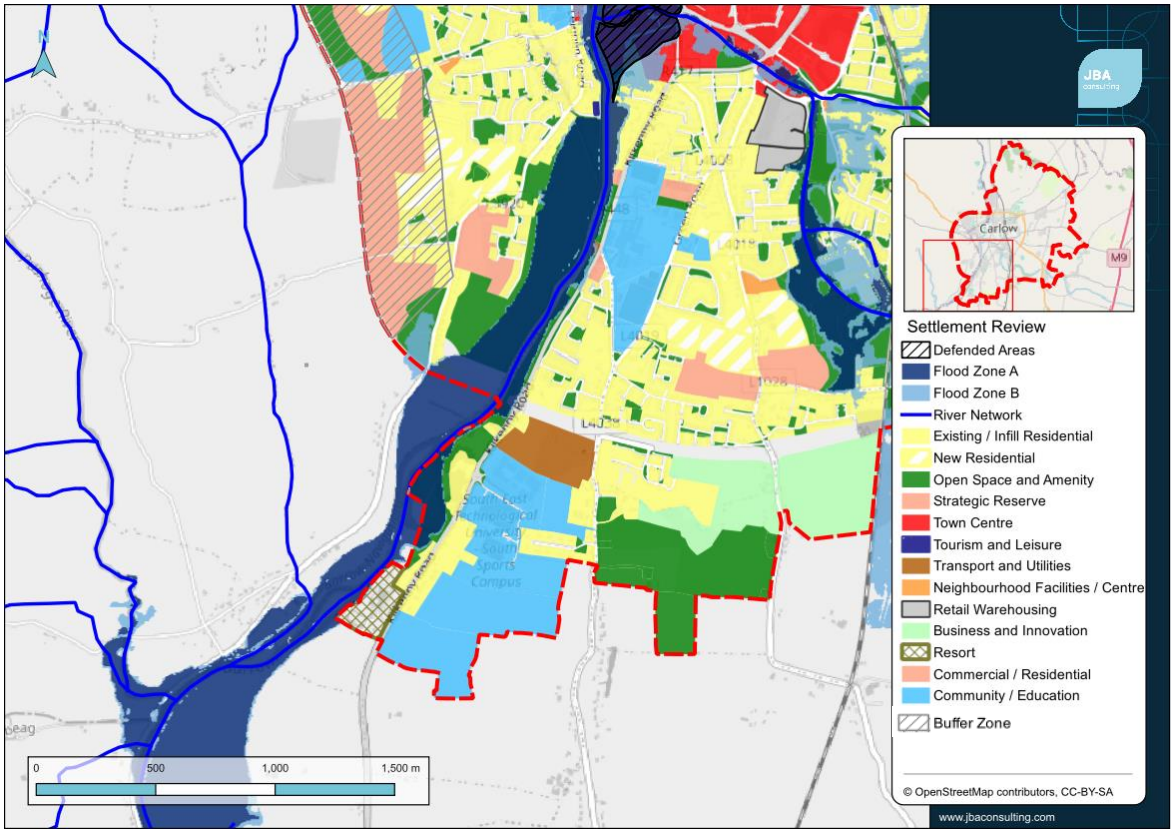
Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	No flood risk scheme present.
Historic Flooding	Flooding has occurred here at Ballinacarrig and on the N80.
Comment	Risk in this area is primarily present in water compatible areas. Risk is limited to Existing/Infill Residential, Open Space and Amenity, Strategic Reserve, Transport and Utilities and Enterprise and Employment.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	Most of the risk is limited to existing developments and since the area is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For Existing Residential; • Development within Flood Zone A/B must be limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • There are to be no bedrooms on the ground floor. • Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA. Risk to existing Transport and Utilities lands comprising of a water treatment

	plant, can be managed on the basis that any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7of the SFRA, and must specifically address the following: • The sequential approach should be applied and Highly vulnerable elements of the site should be located in Flood Zone C, or raised/bunded/protected; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy. For Enterprise & Employment any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • Existing flood data is indicative and does not provide flood levels. An appropriately detailed hydraulic model will be required to confirm flood levels and extents. • The sequential approach should be applied and Highly vulnerable elements of the site should be located in Flood Zone C, or appropriately mitigated; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with SG P2 and the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. For Strategic Reserve there should be no development within the lifetime of the plan within Flood Zone A/B. For other sites within the area manage risk in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.7 Barrow Kilkenny Road (east of River Barrow)



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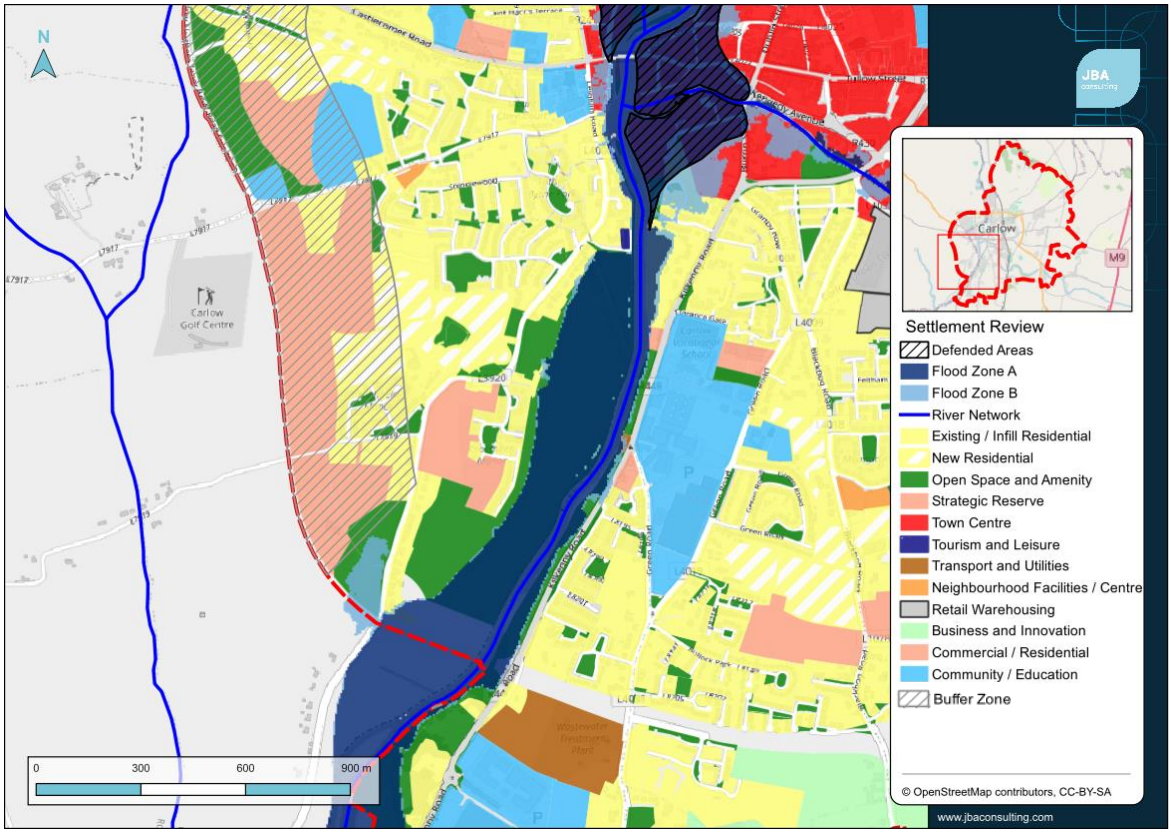
The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity. Areas that benefit from defences are annotated separately.

Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	No flood risk scheme present.
Historic Flooding	Reports of flooding along the Kilkenny Road due to Barrow overtopping.
Comment	Risk is moderate and located along the banks of the Barrow. Risk is limited to Existing/Infill Residential, Resort and Open Space and Amenity.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	Most of the risk is limited to existing developments and since the area is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For Existing Residential development must be; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • There are to be no bedrooms on the ground floor. • Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA. The risk to existing Resort can be managed by following the sequential approach and avoiding less or highly vulnerable development in Flood Zone A and B and according to recommendations contained in Section 7, include: • Flood Zone B would principally be suitable for water compatible use only; • There are to be no bedrooms on the ground floor.

	• FRA should address climate change scenarios in relation to operational levels and potential mitigation measures. For other sites within the area manage risk in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.8 Graiguecullen South (west of River Barrow)



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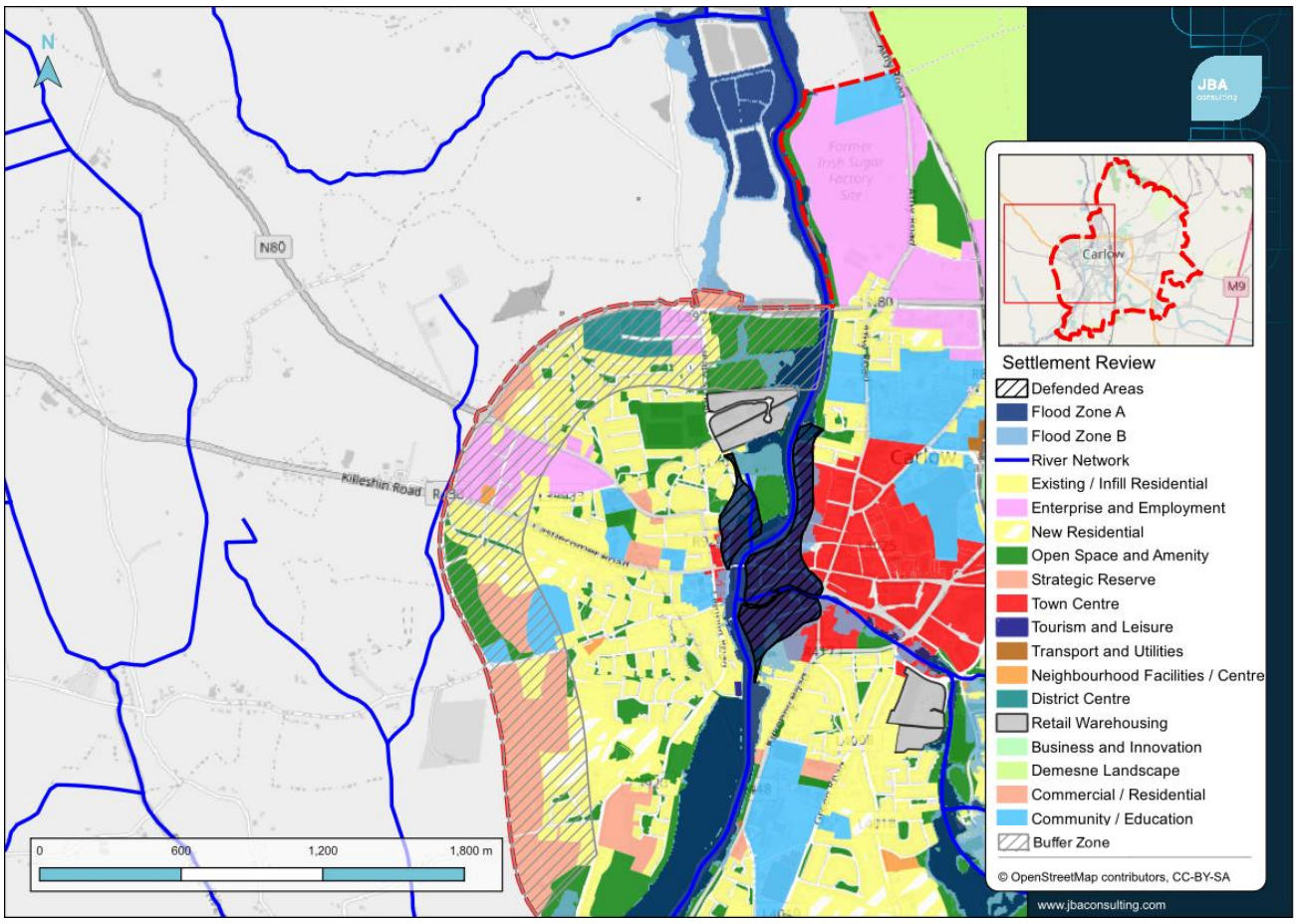
Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	No Flood Relief Scheme present.
Historic Flooding	Reports of flooding in Graiguecullen due to River Barrow overtopping.
Comment	Risk here is related to the Barrow. The risk to Existing/Infill Residential.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	The Derrymoyle Stream is currently an unmapped watercourse that runs outside the settlement boundary to the west. Due to this it is recommended that a Stage 3 Detailed FRA for any planning applications within 350m from the boundary is undertaken. The FRA must specifically model the impacts of the Derrymoyle Stream. Since the area of Graiguecullen South is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended. For Existing Residential within the established Flood Zone A/B or for Strategic Reserve, New Residential, Existing Residential and Community Education within the buffer area then development is managed by the following measures; • For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B: ○ Development should be limited to extensions, renovations and change of use.

	○ Bedrooms should be located in the upstairs of two-story buildings when extending existing property. ○ Infill residential development and demolition and reconstruction can only take place in Flood Zone C. ○ An appropriately detailed FRA will be required which should follow the general guidance provided in Section 7 of the SFRA. For other sites within the area manage risk in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.9 Graiguecullen North West



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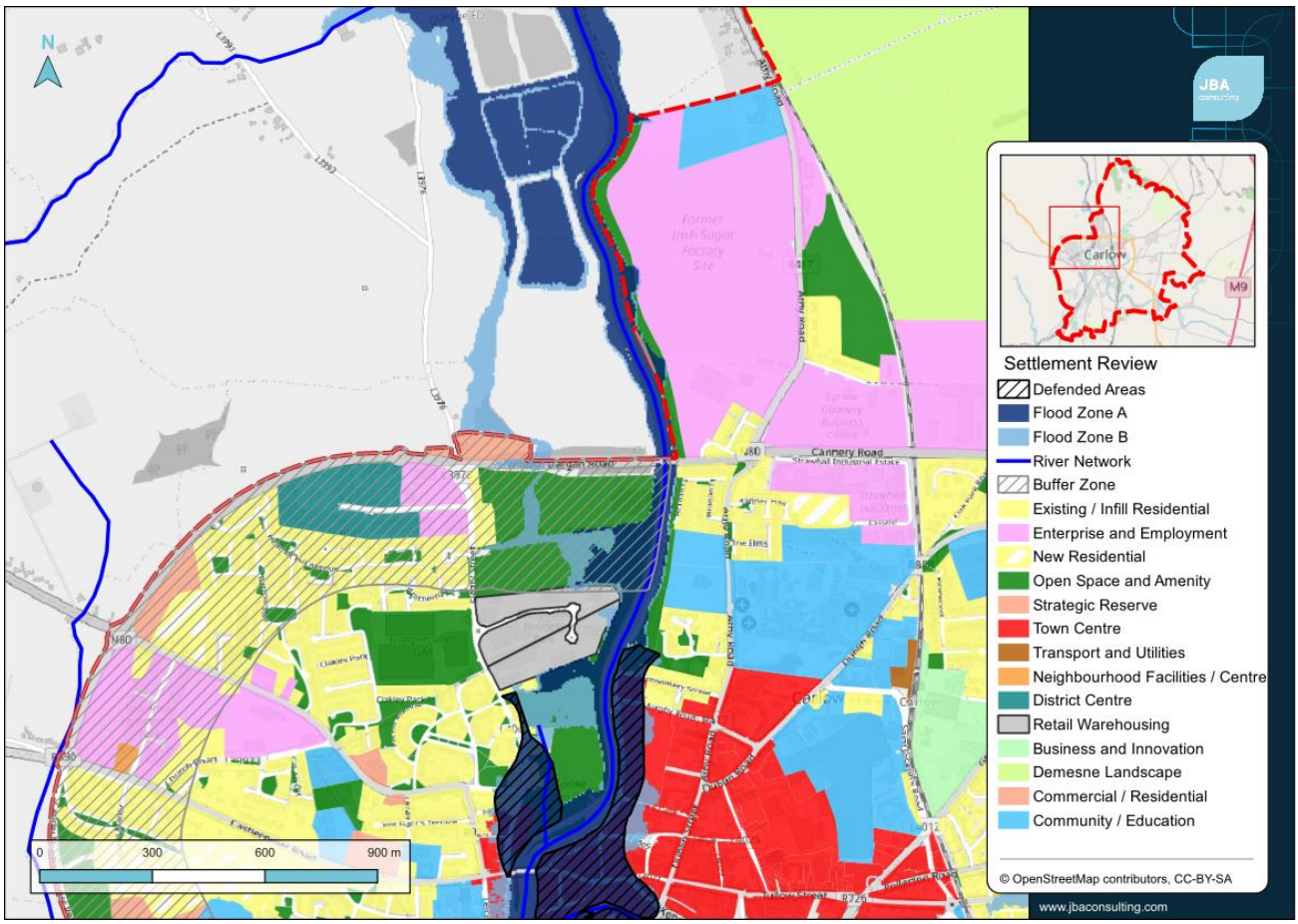
Flood Zone Data	No flood data.
Flood Relief Scheme	No Flood Relief Scheme present.
Historic Flooding	Reports of flooding in Graiguecullen due to River Barrow overtopping.
Comment	Potential risk here is related to the unmapped Derrymoyle stream and the Sleaty Stream flowing to the east, into the Barrow. There may be risk to adjacent lands, this is not likely to be significant but should be clarified at Development Management stage.
Climate Change	No Climate Change data
Conclusion	There are two unmapped watercourses in this area. The Derrymoyle Stream runs outside the settlement boundary to the west and the Sleaty stream flows in an easterly direction towards the Barrow to the north of the area. Due to the presence of these unmapped watercourses it is recommended that a Stage 3 Detailed FRA for any planning applications within 350m from the boundary is undertaken. The FRA must specifically model the impacts of the Derrymoyle Stream and any other local watercourses. Since the area of Graiguecullen West is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For Existing Residential, development is managed by the following measures; • There is no existing flood data or levels. For potential developments

	within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B: o Development should be limited to extensions, renovations and change of use. o Bedrooms should be located in the upstairs of two-story buildings when extending existing property. o Infill residential development and demolition and reconstruction can only take place in Flood Zone C. o An appropriately detailed FRA will be required which should follow the general guidance provided in Section 7 of the SFRA. For the New Residential lands, since these are undeveloped it is a suitable opportunity to apply nature based surface water management in line with SG P2 and the DHLGH Best Practice Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Development is managed by the following measures; • There is no existing flood data or levels. For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B:: o Development should be limited to extensions, renovations and change of use. o Bedrooms should be located in the upstairs of two-story buildings when extending existing property. o Infill residential development and demolition and reconstruction can only take place in Flood Zone C. o An appropriately detailed FRA will be required which should follow the general guidance provided in Section 7 of the SFRA. For District Centre, any future development of the site should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • There is no existing flood data or levels. For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B:: o A Change of use to residential/high vulnerability use would not be appropriate. o FRA should consider flood resistance and resilience measures for any less vulnerable development; o Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; o Any development shall also be required to be built in accordance with CCC SuDS Policy. For Retail Warehousing, any future development of the site should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • There is no existing flood data or levels. For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B: • FRA should consider flood resistance and resilience measures for any less vulnerable development;

	• Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy. For Enterprise & Employment any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • There is no existing flood data or levels. For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B:: o The sequential approach should be applied and Highly vulnerable elements of the site should be located in Flood Zone C, or appropriately mitigated; o FRA should consider flood resistance and resilience measures for any less vulnerable development; o Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; o Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. For Education and Community, any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • There is no existing flood data or levels. For potential developments within the 350m buffer zone or in the current Flood Zone A/B, an appropriately detailed hydraulic model will be required to confirm flood levels/extents within the newly defined Flood Zone A/B::: o The sequential approach should be applied and Highly vulnerable elements of the site should be located in Flood Zone C, or appropriately mitigated; o FRA should consider flood resistance and resilience measures for any less vulnerable development; o Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; o Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. For newly zoned Strategic Reserve Lands that are located to the north of the N80, these are in Flood Zone C but this to the east of the Sleaty Road are at potential risk of fluvial climate change. For future development then it would be most appropriate to consider water compatible uses, which is compatible with the uses permitted in principle for this zoning type. For other sites within the area manage risk in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.10 Graiguecullen North and Former Sugar Factory (east of River Barrow)



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Flood Zone Data	CFRAM (verified by a site visit)
Flood Relief Scheme	No Flood Relief Scheme present.
Historic Flooding	No historical reports of flooding in this area.
Comment	Risk is related to the Barrow. There is limited overlap with Enterprise and Employment and Existing/Infill Residential. Much of the risk is within Open Space and Amenity.
Climate Change	Low sensitivity to climate change, little difference between 1 in 1000 year current and high end future scenario.
Conclusion	Since the area is not within or adjacent to the core town centre the Justification Test cannot pass. On this basis flood risk must be managed in accordance with the sequential approach and Section 5.28 of the Planning Guidelines. As such the following is recommended: For Existing Residential development risk is managed by the following measures within Flood Zone A/B; • Development limited to extensions, renovations and change of use. • Bedrooms should be located in the upstairs of two-story buildings when extending existing property. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. • An appropriately detailed FRA will be required which should follow the general guidance provided in Section 7 of the SFRA.

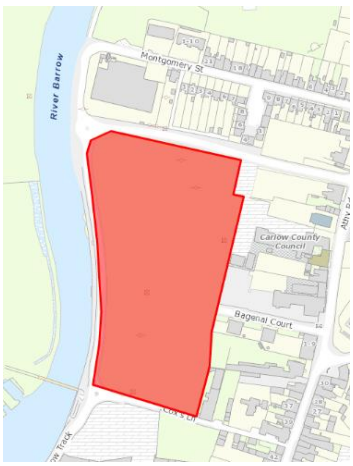
	For the Enterprise and Employment lands and Retail Warehousing any future development of the land should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach must be applied, and less vulnerable elements of the site should be located in Flood Zone B or preferably C; • Highly vulnerable development would only be suitable in Flood Zone C. • Any development shall also be required to be built in accordance with CCC SuDS Policy. • For the undeveloped Enterprise & Employment lands, it is a suitable opportunity to apply nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Elsewhere in the area, risk can be managed in line with CCC approved policy and the guidance provided within Section 7 of this SFRA.

Appendices

A Justification tests

A.1 Town Centre

A.1.1 Town Centre Redevelopment 1 including former Celtic Linen Site (lands immediately to north in flood zone but defended) - The Barrow Track



Site Description

The subject site is located in Carlow Town and includes a significant area for identified for regeneration. The western boundary of the site abuts the Barrow Track and River Barrow. To the north of the regeneration site is Andy Murphy Road, the former Celtic Linen plant, and existing housing fronting and accessed from Montgomery Street. To the east, are the offices of Carlow County Council and other commercial and retail development fronting Dublin Street and the Athy Road. Cox's Lane adjoins the southern boundary. The regeneration site was previously occupied by industrial and storage uses which have since been demolished and removed. The subject site presents a significant opportunity for new development at this location to strengthen the existing mixed uses in a town centre location in Carlow, increasing the service, residential and employment offering in the town.

1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.

Regional Spatial and Economic Strategy: The Regional Spatial and Economic Strategy for the Southern Region 2020-2032 recognises the strategic role of Carlow Town which has been designated a Key Town within the region and as regional and inter-regional economic growth driver. Regional Policy Objective no 14 of the RSES specifically supports development of underused lands along the River Barrow as a strategic natural asset for the town. The growth strategy of the RSES supports the future development of Carlow Town and in particular the need for compact growth, regeneration, placemaking together with its role as an economic growth driver. Key provisions of the RSES which support development of Carlow Town include;

- Designation of Carlow Town as a Key Town to function as an economic self-sustaining regional driver and a focus of significant growth within the county. A population growth rate of more than 30% by 2040 relative to CSO 2016 baseline is targeted for Carlow Town. This entails also delivering important infrastructure and services, ensuring that it can grow as a successful regional employment centre and service hub. RPO 11 sets an objective for delivering population growth and infrastructure provision in Key Towns, as well as promoting sustainable transport, culture, placemaking, tourism development, education, sustainable development, and water infrastructure.
- Supporting town centre led regeneration in Carlow Town, and the development of underutilised lands with improvements to the public realm, investment in infrastructure together with sustainable transport solutions.

- Delivering new homes on urban infill and brownfield land within the town to support urban regeneration with at least 30% of all new homes targeted in settlements (other than the Cities and their suburbs) to be delivered within their existing built-up footprints. (RPO 35)
- Requirement for a coordinated planning framework (JULAP) for the Greater Carlow Urban area to strategically plan for the growth and development of the town, to identify and deliver strategic sites and regeneration areas for the future physical, economic and social development of Carlow Town in conjunction with Laois County Council.
- Supporting the strategic employment development potential of Carlow Town and facilitating economic integration between urban centres throughout the region including Tullow and Muine Bheag.
- Acknowledging the inter-regional role of Carlow town given its location to the north of the Southern Region and adjacent to the Eastern Midlands Regional Assembly region. Opportunities afforded to Carlow are noted as part of a network of regionally significant drivers of collaboration and growth located on the Waterford-Kilkenny-Carlow-Dublin M9/Rail Network/Axis.
- Identifying Carlow Town as an important regional centre of education and research, supporting the establishment of a Multi-Campus Technological University for the South East.

Carlow County Development Plan 2022-2028:

Carlow Town is designated as a Key Town (Tier 1 in the Settlement Hierarchy) in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, implementation of Project Carlow 2040, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level. The success of Carlow as a Key Town will be dependent on the delivery of targeted compact growth of a minimum of 30%, through regeneration and redevelopment of vacant, infill and/or brownfield sites. Carlow town is targeted to accommodate population growth of more than 30% by 2040 relative to CSO 2016 baseline. It is also an objective of the Plan to seek to build on existing economic attributes e.g. third level education provision, proximity to Dublin etc. and to secure continued investment in the town to support increased employment provision and expansion.

Project Carlow 2040, A Vision for Regeneration: Project Carlow 2040, A Vision for Regeneration, identifies the Barrow Track / Civic Spine as a key intervention area providing the opportunity to shape the town's future and deliver an exemplary model for sustainable compact growth in an urban environment. The vision for this area is to create a distinctive mixed-use quarter that brings the river back into the heart of the town centre as a key attribute. It acknowledges that Carlow's Riverfront will play a critical role in the future growth and expansion of the town, complementing other town centre uses, as well as providing connections to Carlow College, Carlow Railway Station, Carlow Castle and more.

Figure; Barrow Track / Civic Spine Regeneration Site

Layout Plan

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

i: Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;

The site is situated on land zoned 'Town Centre' in the Carlow Town Development Plan 2012-2018 (as extended) and as contained in the Joint Spatial Plan for the Greater Carlow Graiguecullen Urban Area 2012-2018. It is identified as an 'Opportunity Site' in Part 11, Section 3 of the Joint Spatial Plan as referred to above i.e. Opportunity Site 2: Barrow Track Site. It is the Policy of the Council to encourage the urban renewal and advancement of opportunity sites. The following policies, objectives and related provisions of the Plan are noted in this regard:

- It is a principle of the Carlow Town Development Plan Core Strategy to "Advance key opportunity sites by preparing development briefs or urban design frameworks". (Pg. 22)
- Objective CO3 seeks to "Present a schedule of landbanks within the Greater Urban Area which offer particular opportunities and are of strategic importance for the future development of the Greater Carlow Graiguecullen Urban Area, offering site briefs for each site".
- Carlow Town Objective CT04 seeks to "Promote the development of the River Quarter and Riverside Regeneration".
- Carlow Town Objective CT05 seeks to "Encourage specific urban renewal projects and advance opportunity sites".
- Policy CTP22 seeks to "Promote the development of opportunity sites with the River Quarter, subject to appropriate assessment, flood risk considerations as well as other general planning considerations".
- Policy CTP30 seeks to "Support the principle of redeveloping…Barrow Track Site (Opportunity Site 2)…".

The regeneration of this site is also supported in the Project Carlow 2040, A Vision for Regeneration as outlined above. It is a strategic objective of the Council (SO 3) as contained in the Carlow County Development Plan 2022-2028 *to support and promote the role of Carlow Town as a Regional and Inter-regional economic growth driver and to fulfil its role as a Key Town, focussed on regeneration, implementation of Project Carlow 2040, sustainable development, quality of life and economic investment.*

ii. **Comprises significant previously developed and/or under-utilised lands &;**
iii. Is within or adjoining the core of an established or designated urban settlement;

The site comprises a brownfield site and is a visually prominent tract of land with significant road frontage along the Barrow Track. Following significant clearance and groundworks, the site presents as a combination of old areas of hard standing / building floor slabs and overgrown stockpiles of soils. The site is located within the town centre and immediately adjoins the Core Retail Area of Carlow Town. It is highly accessible through existing established linkages e.g. Andy Murphy Road and Cox's Lane to Dublin Street and Tullow Street. The under-utilised brownfield site represents an appropriate expansion area for mixed use development facilitating compact development in a sequential manner.

iv. Will be essential in achieving compact and sustainable urban growth;

The subject site comprises a long-standing zoned town centre zoned site. It is considered that the development of this site is essential in realising the compact and sustainable growth of Carlow as it provides for a natural extension to the town centre on a previously developed site. It will enable the development of a new attractive neighbourhood to be developed with frontage to the River Barrow. The land presents the opportunity to expose the River and integrate it back into the public realm as part of a network of amenity areas within and surrounding the town. Opening up the river Barrow through the provision of enhanced walkways, new link streets and the potential for an additional pedestrian bridge will deliver significant benefits for an improved quality of life for residents of the town. Direct routes east and west across the River and through a proposed Civic Spine as well as south to the historic town centre and north to the Barrow way will enhance the quality of place and achieving compact and sustainable urban growth.

v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement;

The subject brownfield lands comprise a significant tract of town centre lands that could facilitate an integrated mixed use development within the town contributing to compact and sustainable urban growth. Alternative lands for the particular mixed-use development which is necessary to contribute to the regeneration of the town and sustainable compact growth are unavailable in areas at lower risk of flooding.

3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment.

The site is now protected to the 1% AEP standard by the Carlow Flood Relief Scheme. Protection is provided by the high level of the Barrow Track (road), rather than a discreet wall or embankment. Site levels adjacent to the road are lower than the road but increase in an easterly direction. A masterplan of the area has been provided under the Carlow 2040 document which has been used to guide the consideration of Part 3.

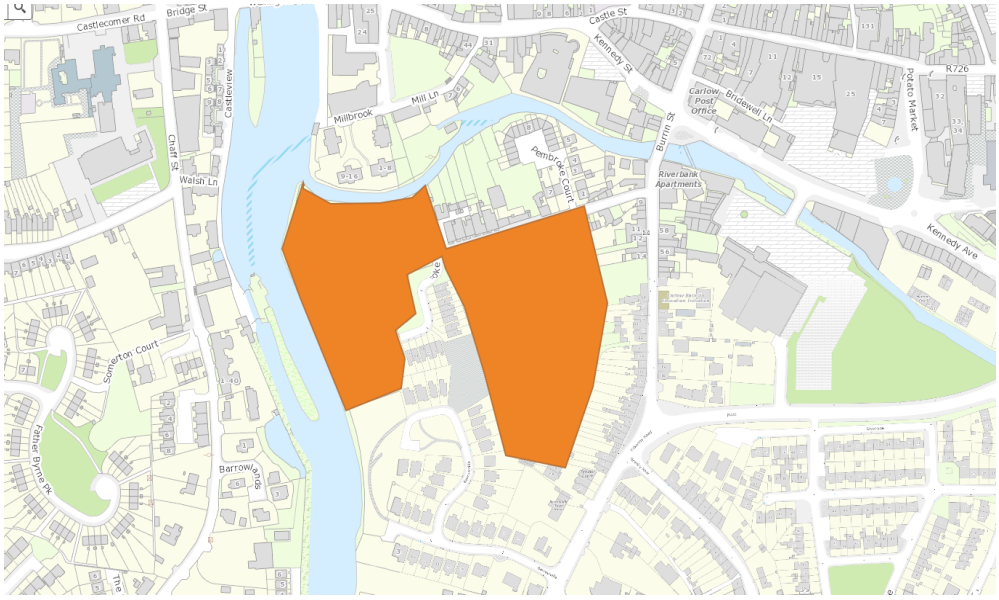
Parts 1 & 2 of the test found that it is considered appropriate to zone the lands as Town Centre.

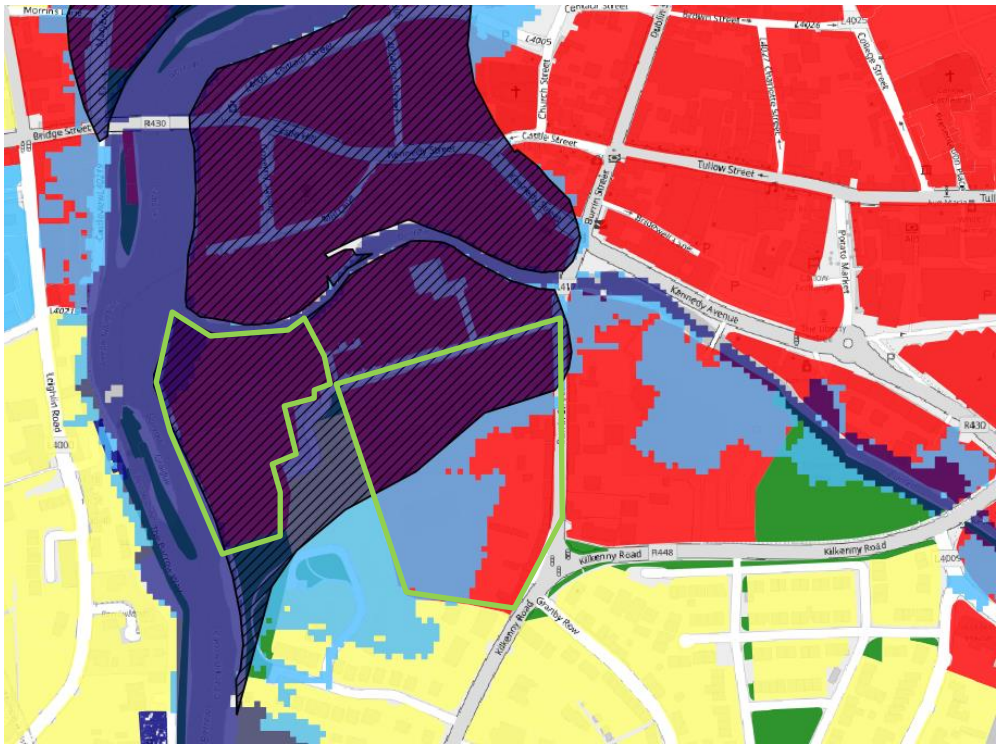
Future development in this area can develop within the defended Flood Zone A and Flood Zone B. Due to the presence of the defences ground levels can be raised appropriately to achieve the design FFL for the type of development proposed, without the need for compensatory storage. All development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following:

- The Masterplan should be subject to an appropriately detailed FRA that finalises the design flood levels and mitigation approach;
- The FRA should address climate change scenarios in relation to FFLs;
- Basement levels are permitted, but no highly vulnerable development would be permitted on this level and the access point to the basement and any vents/opes should be above the design flood level including freeboard;
- Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the

DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

A.1.2 Town Centre Redevelopment 2 - The Pembroke District





Site Description

The subject site is located in Carlow Town and has an area of c. 4ha. The site comprises of two under-utilised land parcels in the Pembroke District, the eastern parcel comprising former industrial land that includes a number of large semi-derelict sheds/warehouses and silos/tanks. The western boundary of the site abuts the River Barrow. To the north is the Burren River and existing housing along Pembroke Road. Located between the two land parcels are existing established residential areas of Barrowville and Pembroke. To the east, are mixed use properties which front Burrin Street. The subject site presents a significant opportunity for new development at this location to strengthen the residential uses in this town centre location in Carlow contributing to the vibrancy and vitality of the town centre.

1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.

Regional Spatial and Economic Strategy: The Regional Spatial and Economic Strategy for the Southern Region 2020-2032 recognises the strategic role of Carlow Town which has been designated a Key Town within the region and as regional and inter-regional economic growth driver. Regional Policy Objective no 14 of the RSES specifically supports development of underused lands along the River Barrow as a strategic natural asset for the town. The growth strategy of the RSES supports the future development of Carlow Town and in particular the need for compact growth, regeneration, placemaking together with its role as an economic growth driver. Key provisions of the RSES which support development of Carlow Town include;

- Designation of Carlow Town as a Key Town to function as an economic self-sustaining regional driver and a focus of significant growth within the county. A population growth rate of more than 30% by 2040 relative to CSO 2016 baseline is targeted for Carlow Town. This entails also delivering important infrastructure and services, ensuring that it can grow as a successful regional employment centre and service hub. RPO 11 sets an objective for delivering population growth and infrastructure provision in Key Towns, as well as promoting sustainable transport, culture, placemaking, tourism development, education, sustainable development, and water infrastructure.
- Supporting town centre led regeneration in Carlow Town, and the development of underutilised lands with improvements to the public realm, investment in infrastructure together with sustainable transport solutions.
- Delivering new homes on urban infill and brownfield land within the town to support urban regeneration with at least 30% of all new homes targeted in settlements (other than the Cities and their suburbs) to be delivered within their existing built-up footprints. (RPO 35)
- Requirement for a coordinated planning framework (JULAP) for the Greater Carlow Urban area to strategically plan for the growth and development of the town, to identify and deliver strategic sites and regeneration areas for the future physical, economic and social development of Carlow Town in conjunction with Laois County Council.
- Supporting the strategic employment development potential of Carlow Town and facilitating economic integration between urban centres throughout the region including Tullow and Muine Bheag.
- Acknowledging the inter-regional role of Carlow town given its location to the north of the Southern Region and adjacent to the Eastern Midlands Regional Assembly region. Opportunities afforded to Carlow are noted as part of a network of regionally significant drivers of collaboration and growth located on the Waterford-Kilkenny-Carlow-Dublin M9/Rail Network/Axis.
- Identifying Carlow Town as an important regional centre of education and research, supporting the establishment of a Multi-Campus Technological University for the South East.

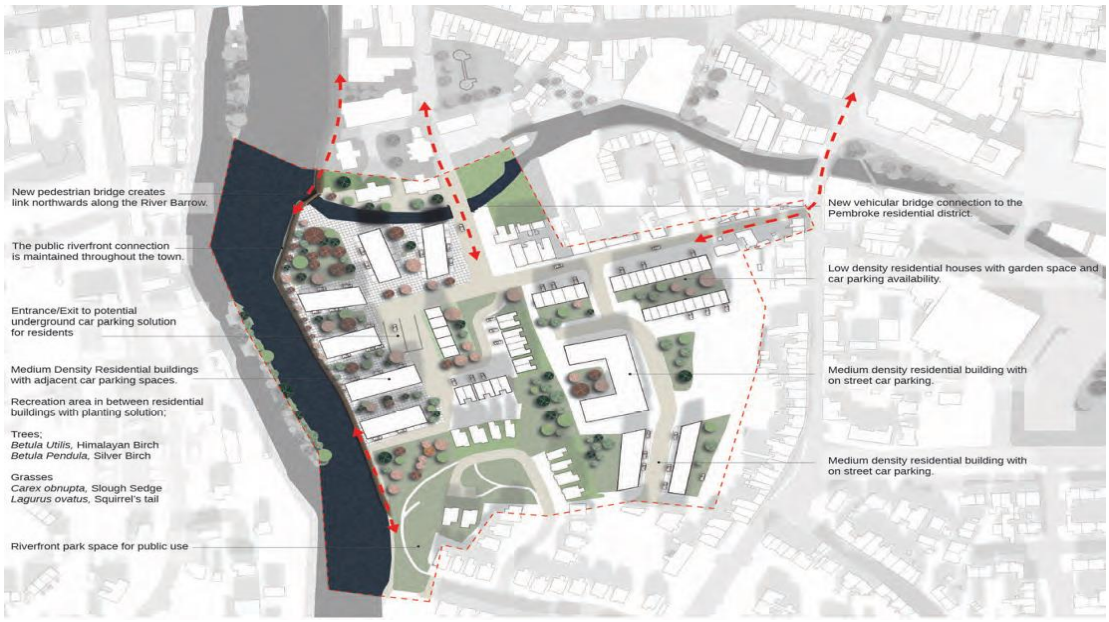
Carlow County Development Plan 2022-2028:

Carlow Town is designated as a Key Town (Tier 1 in the Settlement Hierarchy) in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, implementation of Project Carlow 2040, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level. The success of Carlow as a Key Town will be dependent on the delivery of targeted compact growth of a minimum of 30%, through regeneration and redevelopment of vacant, infill and/or brownfield sites. Carlow town is targeted to accommodate population growth of more than 30% by 2040 relative to CSO 2016 baseline. It is also an objective of the Plan to seek to build on existing economic attributes e.g. third level education provision, proximity to Dublin etc. and to secure continued investment in the town to support increased employment provision and expansion.

Project Carlow 2040, A Vision for Regeneration: Project Carlow 2040, A Vision for Regeneration identifies the Pembroke District as a key intervention area providing the opportunity to reimagine it as a new and vibrant residential quarter that benefits from its position on the banks of the River Barrow, new public spaces and enhanced connections with the Town Centre and key attractions in the immediate vicinity of the site. This intervention is central to the promotion and delivery of compact growth and town centre living as advocated by the National Planning Framework and the Regional Spatial and Economic Strategy. The redevelopment of the area will facilitate integration with the existing urban fabric, improving

the built environment and enhancing access to amenities. The reuse of these lands will also unlock the River Barrow as an amenity asset for both residents of and visitors to the area, including Carlow Castle to the north.

Figure; Pembroke District Regeneration Site



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

i: Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;

The site is situated on land zoned 'Town Centre' in the Carlow Town Development Plan 2012-2018 (as extended) and as contained in the Joint Spatial Plan for the Greater Carlow Graiguecullen Urban Area 2012-2018.

The site is identified as an 'Opportunity Site' in Part 4, Section 3 of the Joint Spatial Plan as referred to above i.e. Opportunity Site 6: Pembroke Road Sites. This overall opportunity site includes lands on the northern and southern sides of Pembroke Road.

It is the Policy of the Council to encourage the urban renewal and advancement of opportunity sites.

The following policies, objectives are related provisions of the Plan are noted in this regard:

- It is a principle of the Carlow Town Development Plan Core Strategy to "Advance key opportunity sites by preparing development briefs or urban design frameworks". (Pg. 22)
- Objective CO3 seeks to "Present a schedule of landbanks within the Greater Urban Area which offer particular opportunities and are of strategic importance for the future development of the Greater Carlow Graiguecullen Urban Area, offering site briefs for each site". (Pg. 24)
- Carlow Town Objective CT05 seeks to "Encourage specific urban renewal projects and advance opportunity sites". (Pg. 205)
- Policy CTP30 seeks to "Encourage the redevelopment of the listed sites having regard to the urban design frameworks…"
-
- (iii) Pembroke Road Sites (Opportunity Sites 6)

The regeneration of this site is also supported in the Project Carlow 2040, A Vision for Regeneration as outlined above. It is a strategic objective of the Council (SO 3) as contained in the Carlow County Development Plan 2022-2028 to support and promote the role of Carlow Town as a Regional and Inter-regional economic growth driver and to fulfil its role as a Key Town, focussed on regeneration, implementation of Project Carlow 2040, sustainable development, quality of life and economic investment. The delivery of the Pembroke District

intervention will support the overall strategy of regeneration in Carlow Town, promote town centre sustainable healthy living and an innovative, culturally rich and socially connected community activity.

ii. **Comprises significant previously developed and/or under-utilised lands &;**

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

The majority of the site comprises vacant and former industrial land including a number of large semi-derelict sheds/warehouses and silos/tanks, previously in use by Drummond Seeds and Pembroke Nursery. A portion of the overall area appears to be in use as a construction compound for the storage of building materials. To the north west of Pembroke Road is located a vehicle recovery business. These existing uses are on under-utilised lands located in a prime town centre location. The under-utilised brownfield site represents an appropriate expansion area for town centre residential development facilitating compact development in a sequential manner.

iv. Will be essential in achieving compact and sustainable urban growth;

The subject site is a long-standing town centre zoned site. It is considered that the development of this site is essential in realising the compact and sustainable growth of Carlow as it provides for a natural extension to the town centre on an under-utilised central town centre site. It will enable the development of a new attractive neighbourhood to be developed with frontage to the River Barrow. The land also presents the opportunity to create a vibrant town centre through the delivery of an enhanced public realm with improved accessibility for sustainable transport modes, improving connectivity between the town centre and the River Barrow and River Burrin. Development of the site will support compact urban growth by building on existing assets and capacity to create critical mass and scale for sustainable living.

v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement;

The subject lands comprise a significant tract of under-utilised town centre lands that could facilitate a new integrated residential district development within the town contributing to compact and sustainable urban growth. Alternative lands for the particular development, which supports healthy town centre initiatives and the creation of vibrant and viable town centres, is necessary to contribute to the regeneration of the town and sustainable compact growth. Lands to achieve compact urban growth on brownfield/infill lands are unavailable in areas at lower risk of flooding.

3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment.

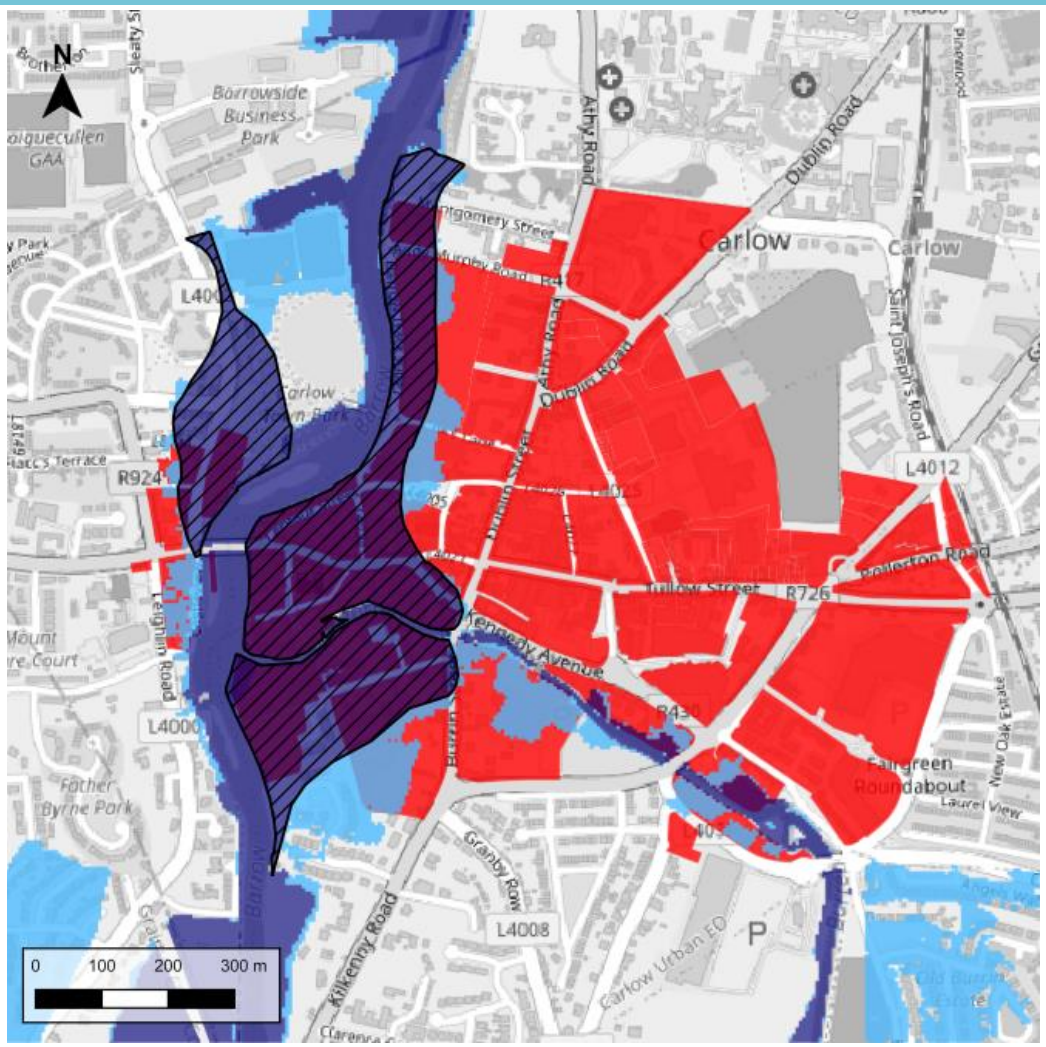
The site is now protected to the 1% AEP standard by the Carlow Flood Relief Scheme. Protection is provided by a floodwall. A masterplan of the area has been provided under the Carlow 2040 document which has been used to guide the consideration of Part 3.

Parts 1 & 2 of the test found that it is considered appropriate to zone the lands as Town Centre.

Future development in this area can develop within the defended Flood Zone A and Flood Zone B. Due to the presence of the defences ground levels can be raised appropriately to achieve the design FFL for the type of development proposed, without the need for compensatory storage. All development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following:

- FRA should address climate change scenarios in relation to FFLs;
- The FRA should also investigate the impacts of defence breach (residual risk) and this should also feed into the FFL;
- Basement levels are permitted, but no highly vulnerable development would be permitted on this level and the access point to the basement and any vents/opes should be above the design flood level including freeboard;
- Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

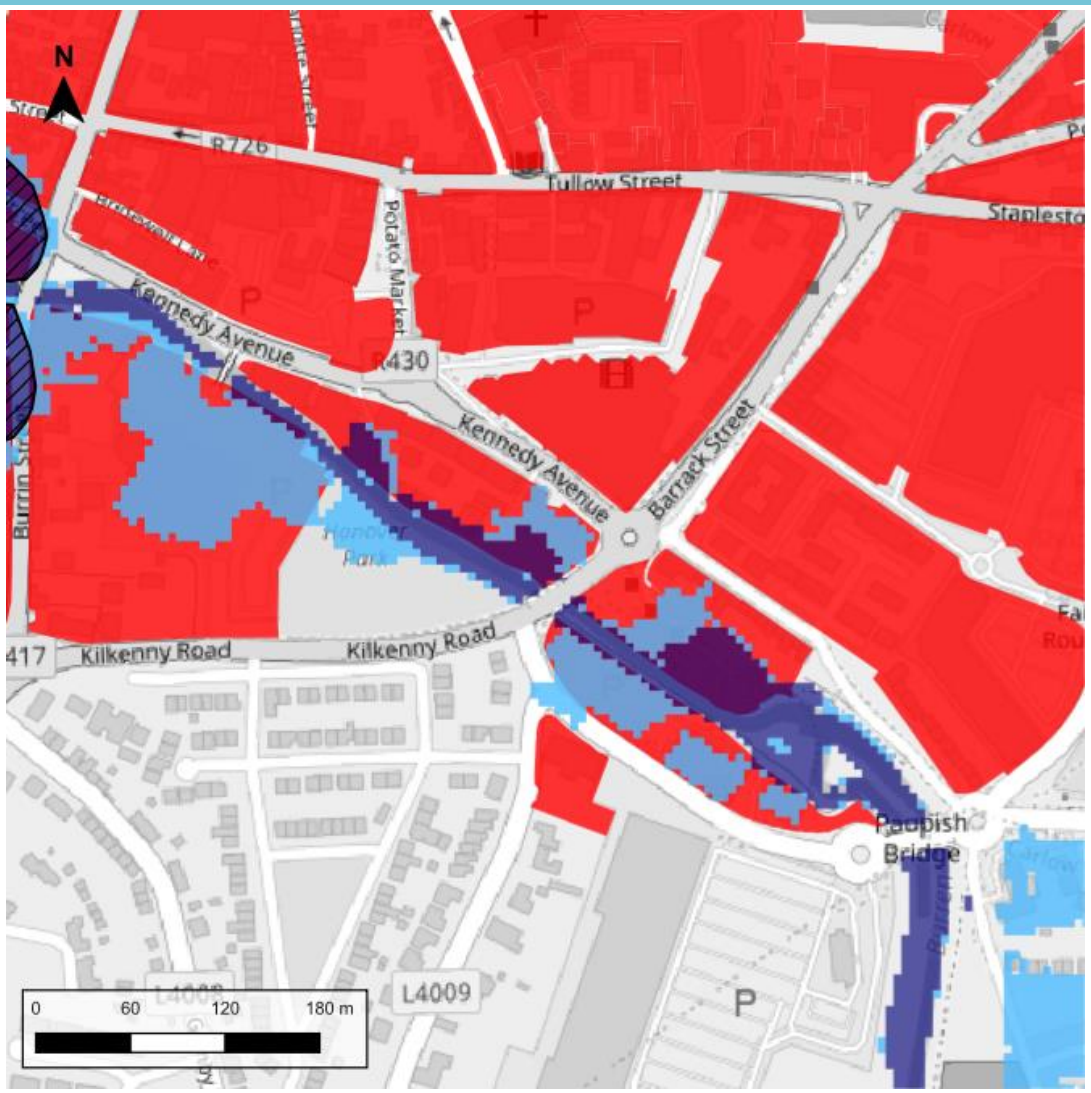
A.1.3 Other Town Centre (defended)



1. The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:	Lands are zoned town centre and amenity and open space reflecting existing established uses on this site.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement:	Existing significantly developed area suitable for regeneration of established uses.
ii. Comprises significant previously developed and/or under-utilised lands:	Yes, comprises significant previously developed land.
iii. Is within or adjoining the core of an established or designated urban settlement:	Yes, is located within the core area of the urban settlement
iv. Will be essential in achieving compact	Lands significantly development with regeneration of this area facilitating the achievement of

and sustainable urban growth;	compact and sustainable growth
v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Lands significantly developed
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	Parts of the Town Centre are within Flood Zone A and defended. Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning. Due to the presence of the defences ground levels can be raised appropriately to achieve the design FFL for the type of development proposed, without the need for compensatory storage. All development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • FRA should address climate change scenarios in relation to FFLs; • The FRA should also investigate the impacts of defence breach (residual risk) and this should also feed into the FFL; • Basement levels are permitted, but no highly vulnerable development would be permitted on this level and the access point to the basement and any vents/opes should be above the design flood level including freeboard; • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

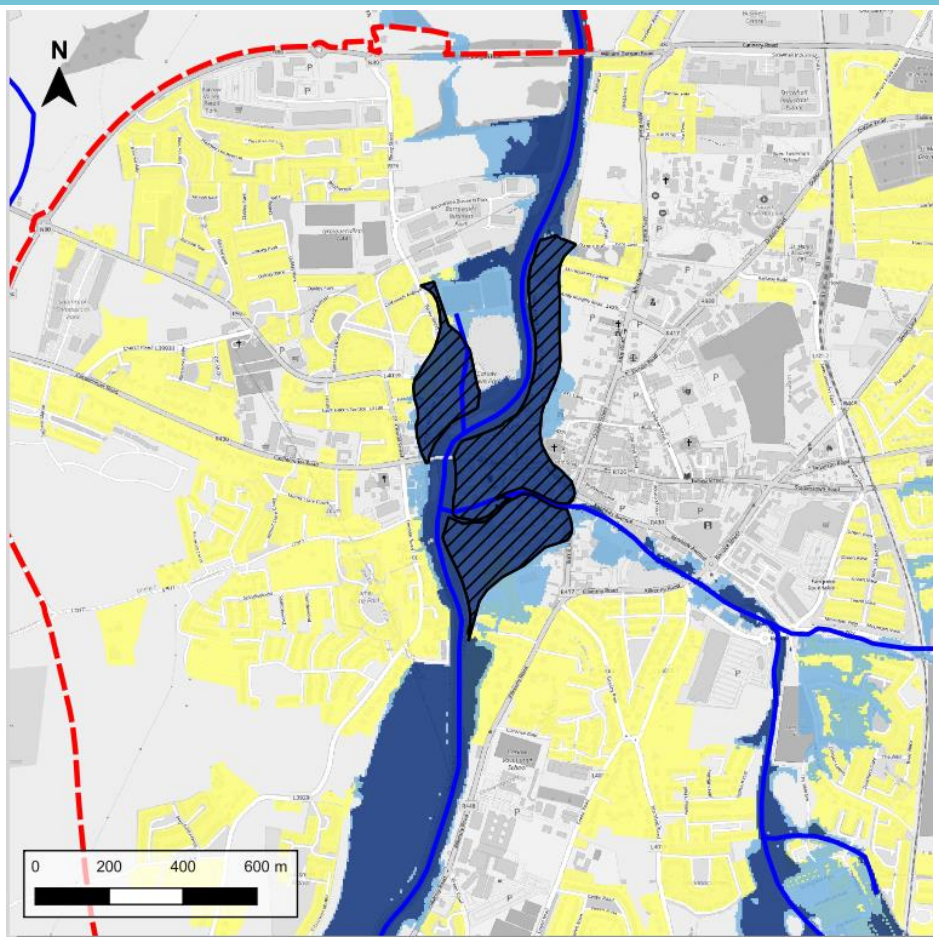
A.1.4 Undefended Town Centre - Burrin River



1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and in particular:	Lands zoned for existing residential / infill and largely developed.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement	Existing development
ii. Comprises significant previously developed and/or underutilised lands,	Yes, comprises significant previously developed lands
iii. Is within or adjoining the core of an established or designated urban settlement,	Yes, is within the established designated urban settlement
iv. Will be essential in achieving compact	Lands already developed

and sustainable urban growth, and	
v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Lands already developed
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	The Burrin River overtops its banks and undefended Flood Zone A/B extends into existing developed lands. For the most part Flood Zone A extends into lands that are subject to open space (e.g. Hanover Park) but some areas of existing Town Centre are at risk. Flood Zone B extends into lands that are under existing commercial/retail use and the key site is the Penneys redevelopment which has extant planning permission for redevelopment and was subject to an appropriately detailed FRA. Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning. This is on the basis that within areas not benefitting from the FRS (undefended) development is; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • FRA should address climate change scenarios in relation to FFLs and potential mitigation measures; • Residential FFLs should be above the 1% AEP level plus climate change and freeboard; • Bedrooms should be located in the upstairs of two-story buildings when extending existing property; • Flood resilient construction materials and fittings should be considered if in Flood Zone A/B; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Emergency evacuation plan and defined access / egress routes should be developed for extreme flood events. • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

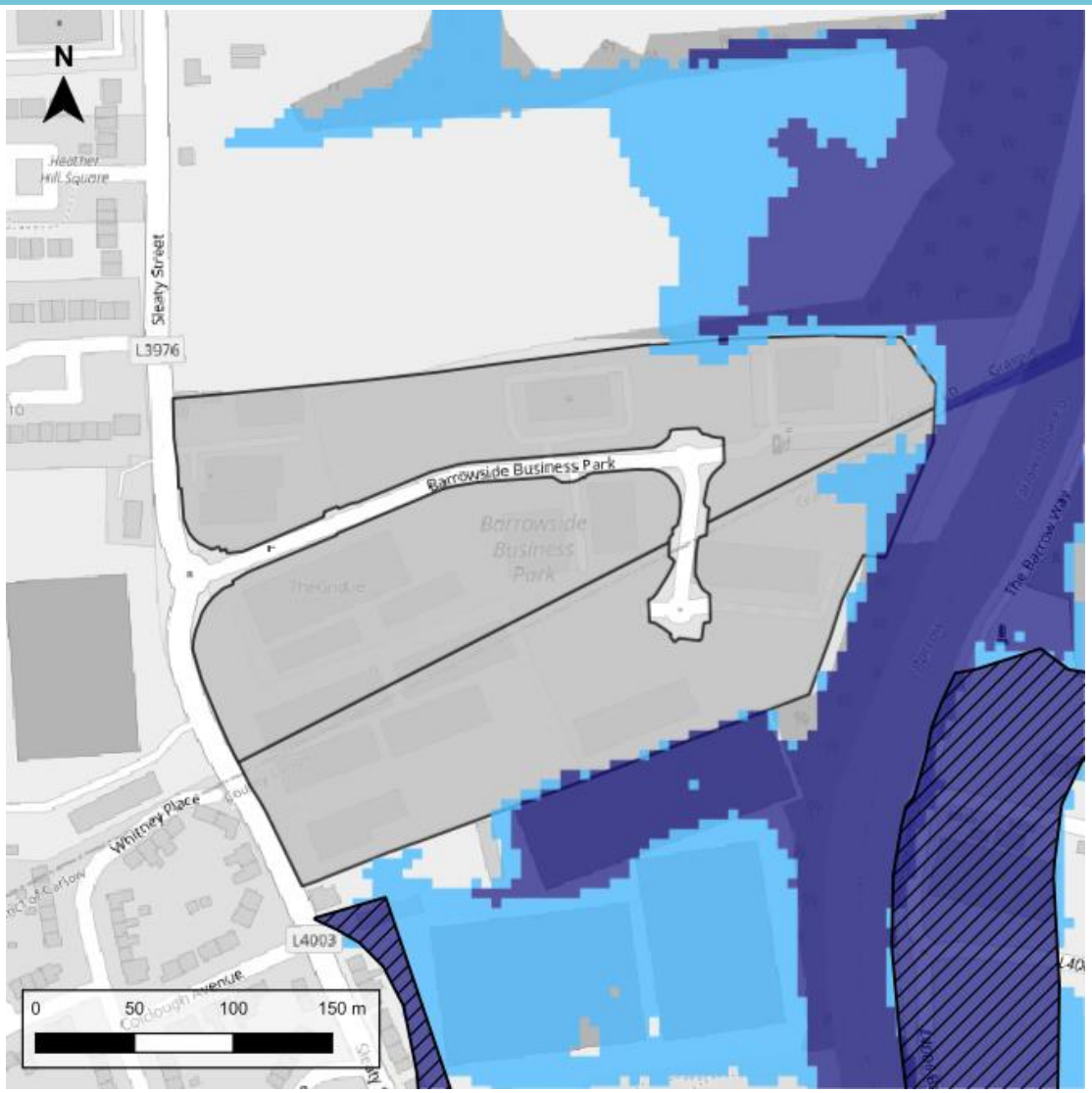
A.1.5 Existing/Infill Residential (undefended) - Barrowville



1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and in particular:	Lands zoned for existing residential / infill and largely developed.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement	Existing development
ii. Comprises significant previously developed and/or underutilised lands,	Yes, comprises significant previously developed lands
iii. Is within or adjoining the core of an established or designated urban settlement,	Yes, is within the established designated urban settlement
iv. Will be essential in achieving compact and sustainable urban growth, and	Lands already developed
v. There are no suitable alternative lands for the particular use or development type, in	Lands already developed

areas at lower risk of flooding within or adjoining the core of the urban settlement.	
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	The Barrow River presents flood risk to a significant area of existing residential land. Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning. This is on the basis that within areas not benefitting from the FRS (undefended) development is; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • FRA should address climate change scenarios in relation to FFLs and potential mitigation measures; • Residential FFLs should be above the 1% AEP level plus climate change and freeboard; • Bedrooms should be located in the upstairs of two-story buildings when extending existing property; • Flood resilient construction materials and fittings should be considered if in Flood Zone A/B; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Emergency evacuation plan and defined access / egress routes should be developed for extreme flood events. • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

A.1.6 Retail Warehousing - Town Centre lands bounding the Burrin River

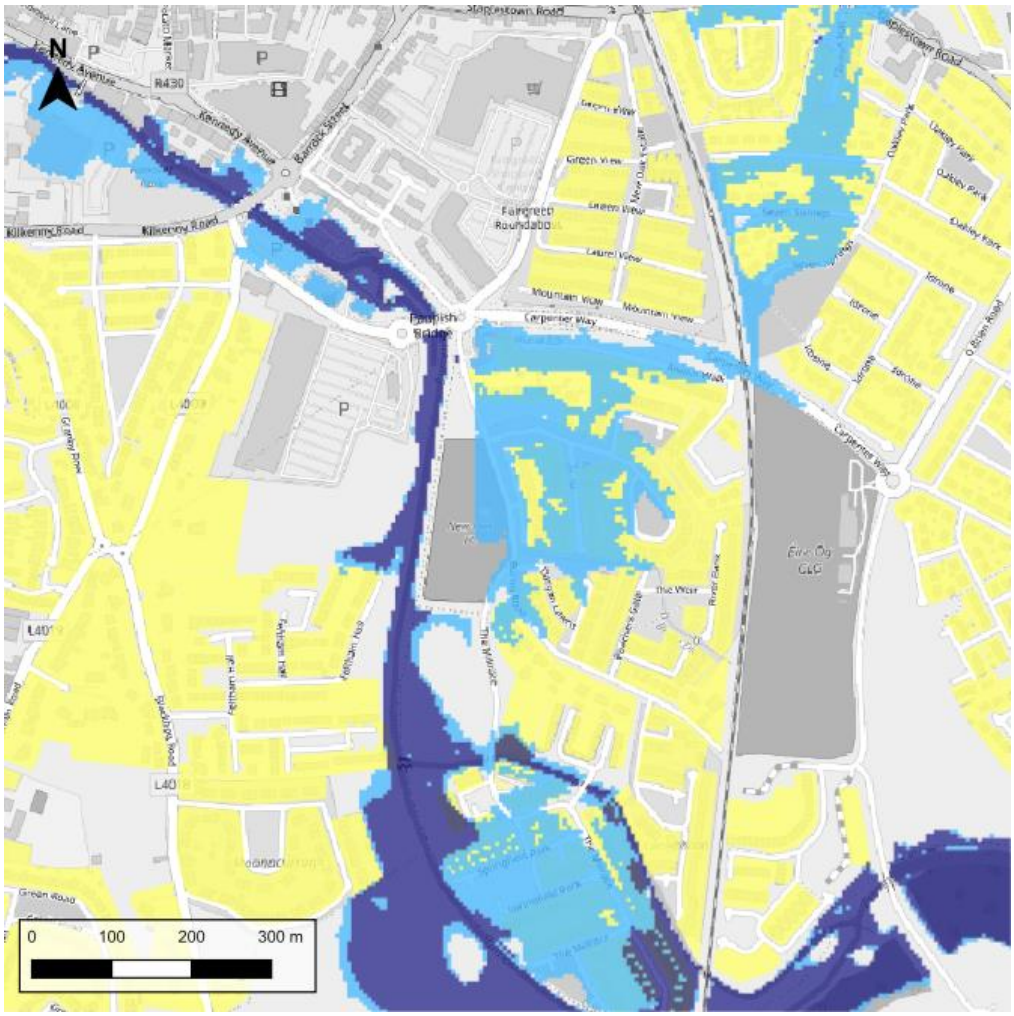


1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and in particular:	Lands zoned for retail warehousing and largely developed.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement	Existing development
ii. Comprises significant previously developed and/or underutilised lands,	Yes, comprises significant previously developed lands
iii. Is within or adjoining the core of an established or designated urban settlement,	Yes, is within the established designated urban settlement

iv. Will be essential in achieving compact and sustainable urban growth, and	Lands already developed
v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Lands already developed
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	The Barrow River has a limited overlap with the Retail Warehousing lands. Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning. This is on the basis that development is limited to the existing vulnerability use and extensions/refits/change of use. Significant redevelopment within Flood Zone A/B would not be appropriate as there is no recommended flood relief scheme for the area. Any future planning applications for extensions/refits/change of use should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach should be applied if possible; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Emergency evacuation plan and defined access / egress routes should be developed for extreme flood events. • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

A.2 Mill Race/Springfield Area

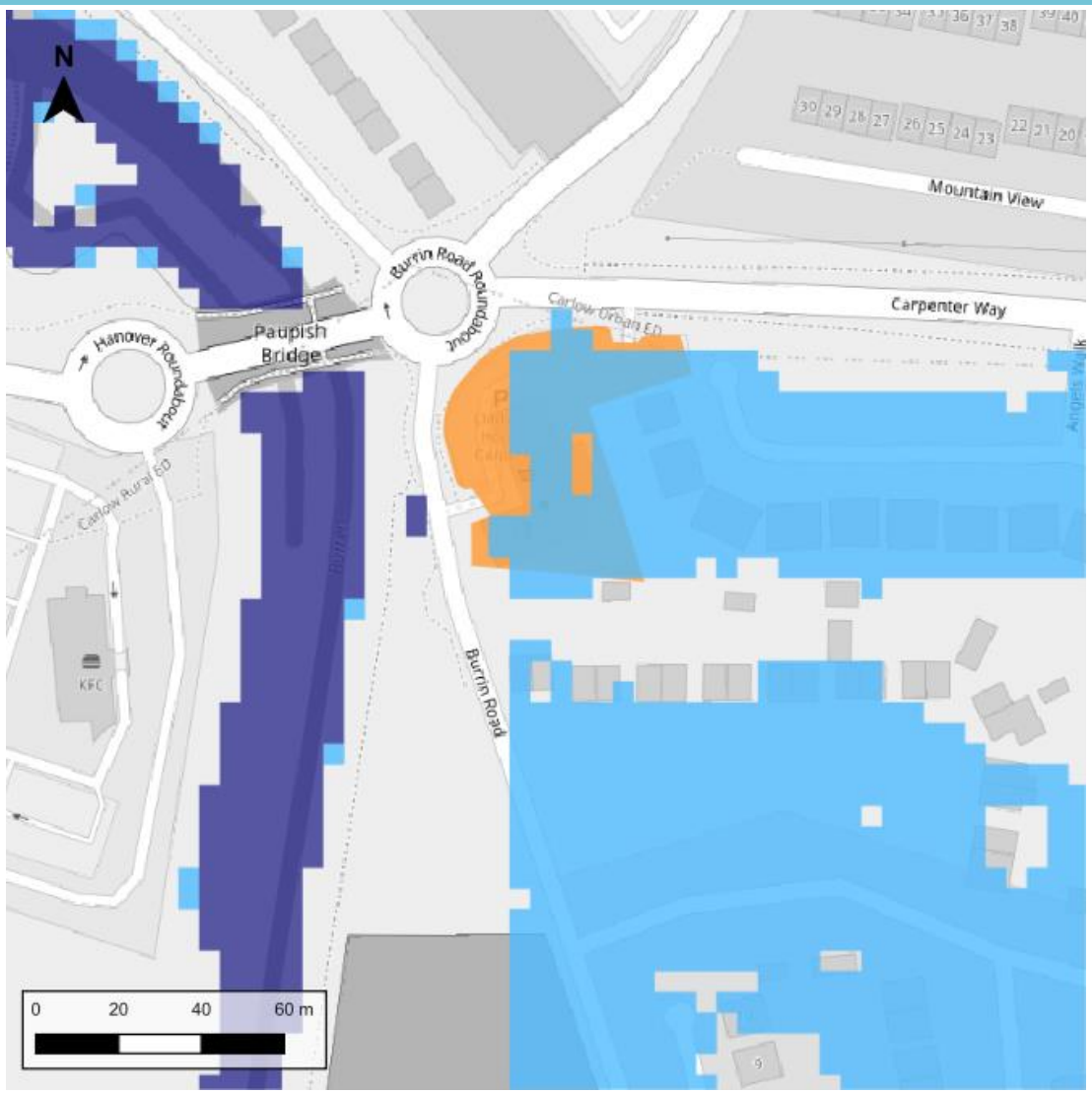
A.2.1 Existing Residential



1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and in particular:	Lands zoned for existing residential / infill and largely developed.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement	Existing development
ii. Comprises significant previously developed and/or underutilised lands,	Yes, comprises significant previously developed lands
iii. Is within or adjoining the core of an established or designated urban settlement,	Yes, is within the established designated urban settlement
iv. Will be essential in achieving compact	Lands already developed

and sustainable urban growth, and	
v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Lands already developed
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning. This is on the basis that within areas not benefitting from the FRS (undefended) development is; • Limited to extensions, renovations and change of use. • Infill residential development and demolition and reconstruction can only take place in Flood Zone C. Any future development should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • FRA should address climate change scenarios in relation to FFLs and potential mitigation measures; • Residential FFLs should be above the 1% AEP level plus climate change and freeboard; • Bedrooms should be located in the upstairs of two-story buildings when extending existing property; • Flood resilient construction materials and fittings should be considered if in Flood Zone A/B; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Emergency evacuation plan and defined access / egress routes should be developed for extreme flood events. • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.

A.2.2 Neighbourhood Facilities/Centre



1. The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy (RSES), statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Carlow Town is designated as a Key Town in the RSES and in the Settlement Hierarchy in the Carlow County Development Plan 2022-2028. The strategic vision for Carlow Town is to support and promote the role of Carlow Town as a regional and inter-regional economic growth driver and to fulfil its role as a key town, focused on regeneration, sustainable development, quality of life and economic investment. As a designated Key Town, Carlow Town is to play a critical role in underpinning the RSES and ensuring a consolidated spread of growth beyond cities at a sub-regional level.
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and in particular:	Lands zoned for neighbourhood centre and largely developed.
i. Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement	Existing development
ii. Comprises significant previously developed and/or underutilised lands,	Yes, comprises significant previously developed lands
iii. Is within or adjoining the core of an established or designated urban settlement,	Yes, is within the established designated urban settlement

iv. Will be essential in achieving compact and sustainable urban growth, and	Lands already developed
v. There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Lands already developed
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere. N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment	There is limited overlap with Flood Zone B and the existing Neighbourhood Facilities lands. Parts 1 & 2 of the test found that it is considered appropriate to retain the existing zoning for the site. Any future expansion of the site should be subject to an FRA which should follow the general guidance provided in Section 7 of the SFRA and must specifically address the following: • The sequential approach should be applied and any extensions or further development should be located in Flood Zone C; • Flood Zone A/B would principally be suitable for playing pitches/water compatible use only; • FRA should address climate change scenarios in relation to operational levels and potential mitigation measures; • Proposals should not impede existing flow paths or cause flood risk impacts to the surrounding areas, and; • Any development shall also be required to be built in accordance with CCC SuDS Policy including consideration of nature based surface water management in line with the DHLGH Best Practise Interim Guidance Document; Nature-Based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas.