Patrickswell Local Area Plan 2024-2030 Strategic Flood Risk Assessment

Live Document

April 2024

www.jbaconsulting.ie

Limerick City and County Council

Merchants Quay

Limerick

JBA Project Manager

Ross Bryant
Unit 24 Grove Island
Corbally,
Limerick,
Ireland

Revision history

Revision Ref/Date	Amendments	Issued to
S3-P01 27 June 2023	Draft Report for initial review.	Limerick City and County Council
S3-P02 30 June 2023	Draft Report for initial review.	Limerick City and County Council
S3-P03 25 July 2023	Updated Draft Report for display	Limerick City and County Council
S3-P04 25 August 2023	Updated Draft Report for display	Limerick City and County Council
S3-P05 04 March 2024	Finalised	Limerick City and County Council
S3-P06 31 March 2024	Finalised	Limerick City and County Council

This report describes work commissioned by Limerick County Council.

Prepared by ..... Fiona Byrne BSc MSc

Analyst

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

Associate Director

Purpose

This document has been prepared as a SFRA for Limerick City and County Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Limerick County Council.

Copyright

Carbon footprint

A printed copy of the main text in this document will result in a carbon footprint of 58g if 100% post-consumer recycled paper is used and 173g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Contents

List of Figures

List of Tables

Abbreviations

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

1 Introduction

JBA Consulting was appointed by Limerick City and County Council to carry out the Strategic Flood Risk Assessment for the Patrickswell Local Area Plan 2024-2030.

This report details the SFRA for this area and has been prepared in accordance with the requirements of the DoEHLG, OPW Planning Guidelines, The Planning System and Flood Risk Management[1]; these guidelines were issued under the Planning and Development Act 2000 (as amended) and recognise the significance of proper planning to manage flood risk.

1.1 Terms of Reference

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 Patrickswell Local Area Plan 2024-2030 (PLAP) will be the key document for setting out a vision for the development of Patrickswell during the plan period.

It is important that the PLAP 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 PLAP, the main requirements of the SFRA are to:

- Produce Flood Zone Mapping for the 2024-2030 plan.
- Prepare a Stage 2 - Flood Risk Assessment of Patrickswell 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 cognisance of the Limerick Climate Adaptation Strategy 2019-2024, the National Climate Adaptation Framework and the various environmental and visual designations applicable to Patrickswell.
- 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 Local Area Plan for Patrickswell. The context of flood risk in Patrickswell is considered with specific reference to a range of flood sources, including fluvial, pluvial, groundwater, sewer and artificial reservoirs and canals.

---

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

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 Local Area 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 Patrickswell has flooded in the past and confirms that a proportion of zoned lands are at flood risk. The SFRA must protect lands for any 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 Patrickswell.

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

In Section 4 the available data related to flooding is summarised and appraised and outlines the sources of flooding to be considered, based on the review of available data. 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 Local Area 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 Section 9.

2 Patrickswell Study Area

2.1 Introduction

The plan area comprises the full extent of Patrickswell and is located to the west of the M20 motorway from Limerick to Cork. Patrickswell is situated in the Ballynaclogh catchment which is within the Shannon estuary south catchment. The Barnakyle River flows through the village in a northerly direction, parallel to this the Patrickswell river flows to the east of the village and west of the Limerick racecourse in a northerly direction. The Patrickswell river confluences with the Barnakyle to the north and then flows in a westerly direction towards the Maigue. Lands within the LAP contain a mix of agricultural, residential, and commercial lands.

2.2 Watercourses

The primary watercourse in the Patrickswell area is the Barnakyle River which drains an area of approximately 41.39km². The Barnakyle River rises just south of Patrickswell where it flows in a northerly direction towards the Barnakyle river and then the Shannon Estuary.

The Patrickswell River is also a tributary of the Barnakyle River and drains an area of 41.39km², it rises to the south of the village where it flows north and then west towards the Shannon Estuary.

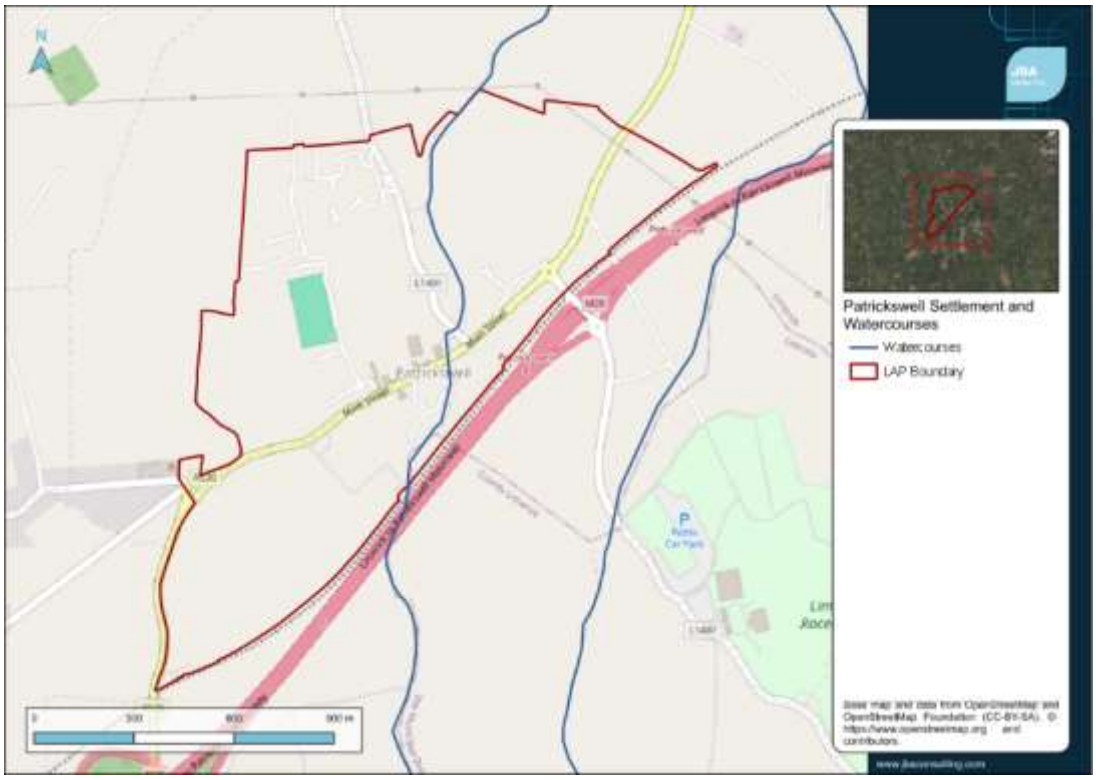


Figure 2-1: Patrickswell settlement and rivers

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 (RSES)

The main purpose of the Regional Spatial and Economic Strategy (RSES) is to support the implementation of the NPF and wider Project Ireland 2040 aspirations. The RSES also supports the economic policies and objectives of the Government by providing a detailed strategic planning and economic framework for the development of the Southern Region. As Limerick forms part of the Southern Region, the plan must comply with the provisions of the RSES. The RSES provides a framework for the development of the region up to 2032. It focuses on the delivery of housing, job creation, infrastructure, community facilities and ensuring that the region remains attractive for investment.

Patrickswell is located approximately 10km southwest of Limerick City, to the west of the M20 motorway from Limerick to Cork. It is part of the Limerick-Shannon Metropolitan area and is a commuter village for Limerick city.

Of relevance to the SFRA is the overarching policy of rationalising the residential land use in Patrickswell and providing compact growth and development that accommodates envisaged housing needs and diversity. Since a proportion of the core village centre is at risk of flooding this presents a challenge when managing flood risk and development.

2.3.3 The Limerick Development Plan 2022-2028

The current Limerick Development Plan covers the period 2022-2028. The plan sets out compliance with the National Planning Framework and the Regional Spatial and Economic Strategy for the Southern Region. As part of the Limerick Development Plan 2022-2028 a Strategic Flood Risk Assessment was undertaken in accordance with the Planning System and Flood Risk Management Guidelines for Planning Authorities (2009). The purpose of the SFRA is to identify flooding or surface water management issues related to Limerick to inform strategic land use planning decisions.

The Limerick Development Plan 2022-2028 considered flood risk in reference to people, business, infrastructure, and the environment at risk of flooding. The LDP proposed to minimize the risk of flooding through the identification and management of existing and particularly potential future flood risks. The SFRA proposed this be completed by following the sequential approach and application of the Justification Test set out in the 2009 Guidelines on Planning and Flood Risk Management (DoEHLG) throughout the planning process.

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.

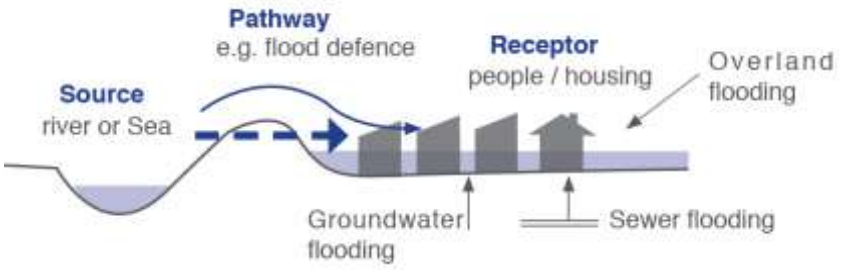


Figure 3-1: Source Pathway Receptor Model

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 and 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 Local Area 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 and villages 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
JBA flood mapping	Covers the Barnakyle River	High	Detailed 1D/2D HPW model based on site channel survey and LiDAR data. Site verified by walkover and consultation with the Local Authority.
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 event and spot coverage for other events	Various	Highly useful oversight of historic flooding issues provided by Local Authority.
LiDAR height model	Patrickswell 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 County Limerick, is principally derived from the CFRAM, where possible. However, the Barnakyle River is not covered by the CFRAM and so, a detailed hydrological study was carried out and has been used to define the Flood Zones. All sources of available flood mapping were reviewed, and the best available dataset is used.

Specific guidance is provided for each area of Patrickswell 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 LCCC 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.

4.1 Historic Flooding

It is reported that Patrickswell has 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. Floodinfo.ie does not show any flood events in Patrickswell. Local information has indicted localised flooding due to culvert constrictions. There were also reports of surface water flooding at St. Mary's cemetery on August 31st, 2020.

4.2 Site Walkover

As part of the SFRA process a site walkover and consultation was undertaken in Patrickswell by an experienced Flood Risk Manager alongside the Local Authority Engineer. The site walkover took place on 20/04/2023 and aimed to assess risks presented by potentially unmapped watercourses and to verify CFRAM mapping.

The walkover took place at specific locations throughout Patrickswell based on OSi mapping. The mapping produced by JBA was generally found to be in agreement with observations made during the walkover and the data was approved for use.

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 focused 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 predictive mapping is displayed over page in Figure 4-1 and Figure 4-2 and confirms that there is no predicted groundwater flood groundwater flooding within the LAP boundary.

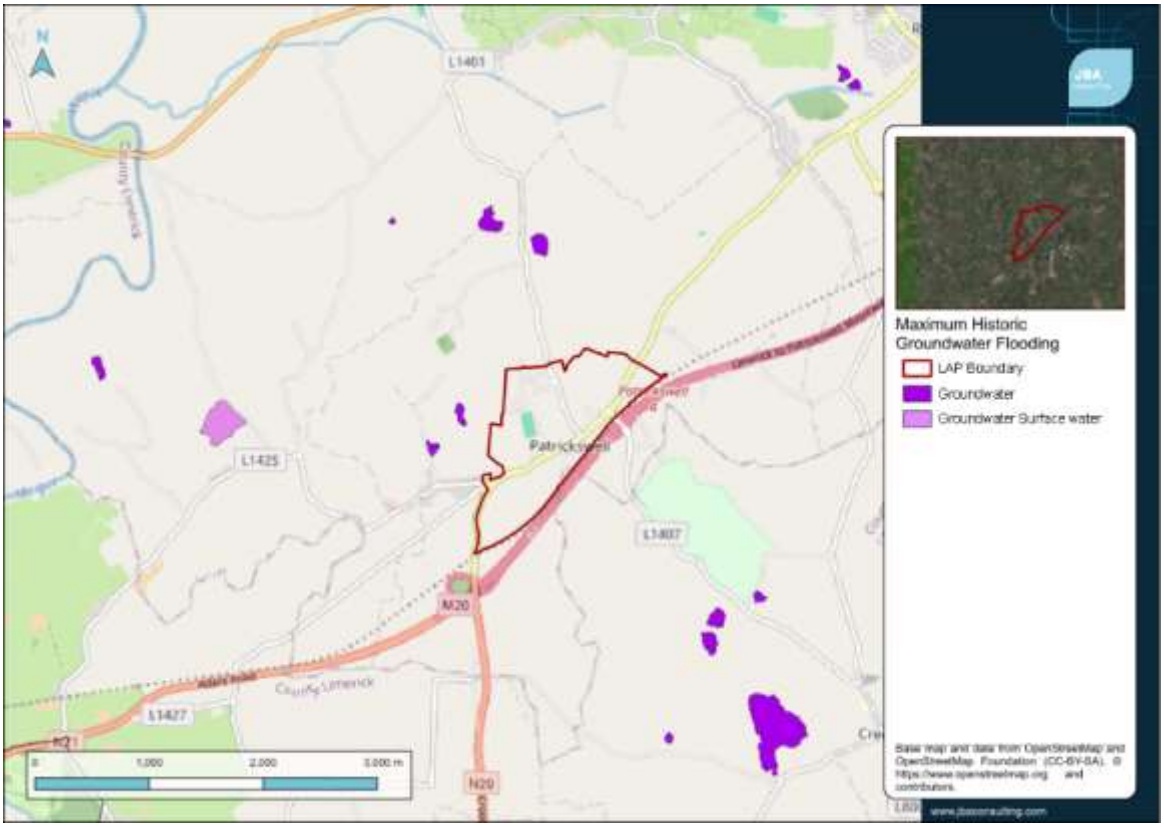


Figure 4-1 Maximum Historic Groundwater Flooding

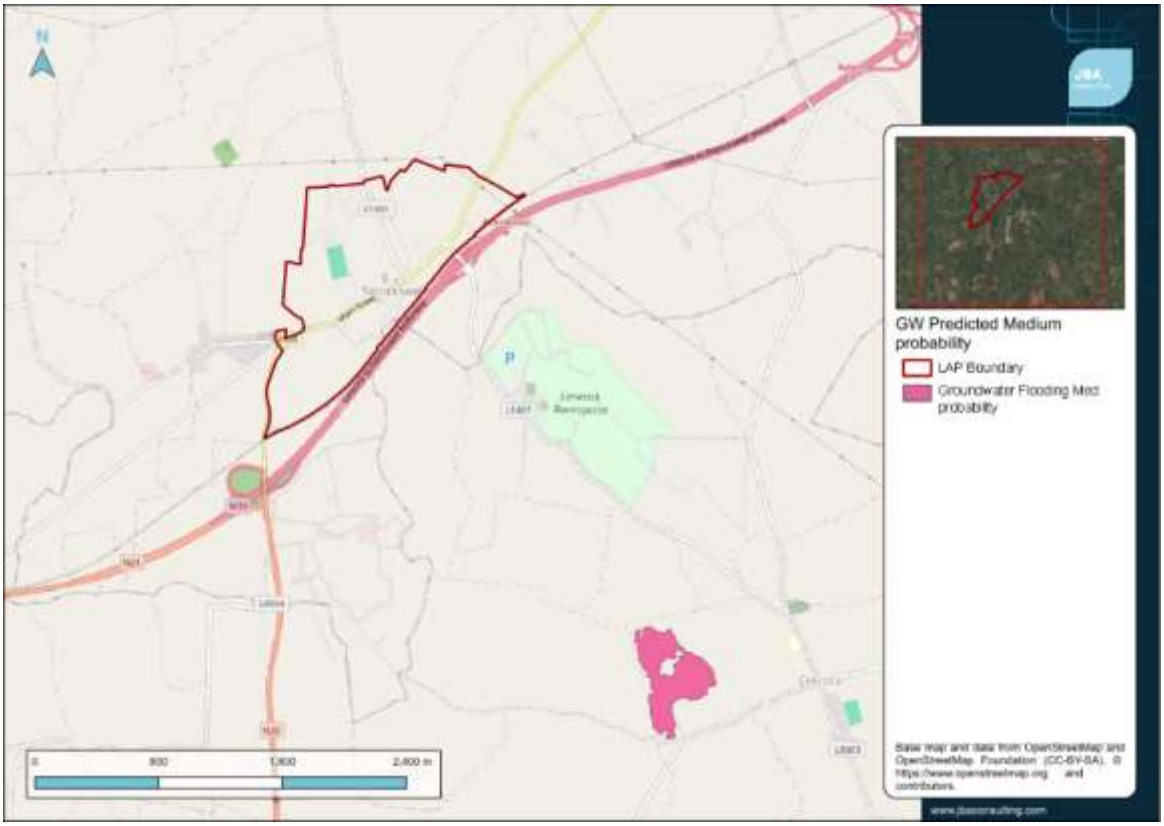


Figure 4-2 Groundwater Flooding Medium Probability

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 flood events since the 2015/2016 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 for 2015/2016 is displayed within Figure 4-3 and was reviewed on site during the walkover in April 2023.

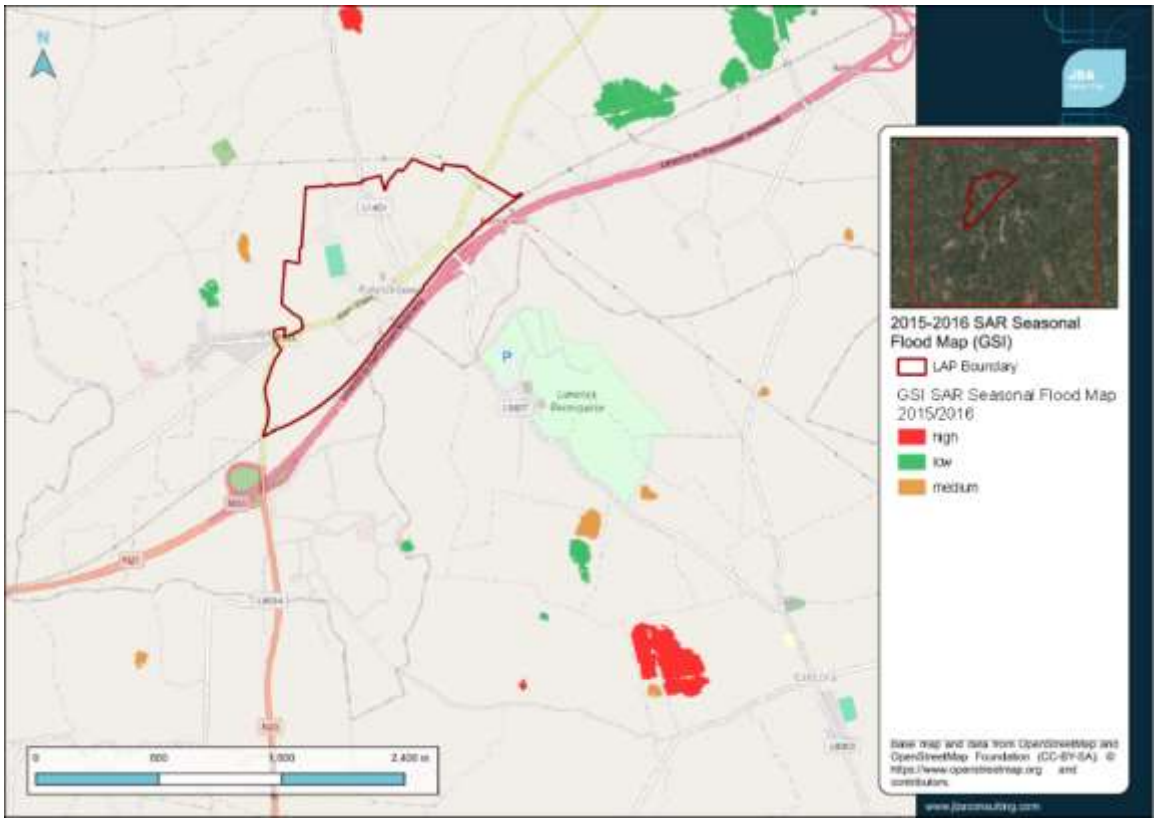


Figure 4-3 2015-2016 SAR Seasonal Flood Map (GSI)

4.5 JBA Detailed Hydraulic Modelling – Barnakyle River

A tributary of the Maigue called the Barnakyle River, flows north through the village to the north and is culverted under the M20 and again under the R526. The watercourse was not modelled under the CFRAM programme or covered by the NIFM mapping. JBA undertook a detailed 1D-2D hydraulic model of the watercourse using the ESTRY-TuFLOW software package. The model was supported by channel survey undertaken by a specialist survey contractor and hydrological estimation/assessment. Results were used to create Flood Zone A/B and have been amalgamated with the wider Flood Zones for Limerick.

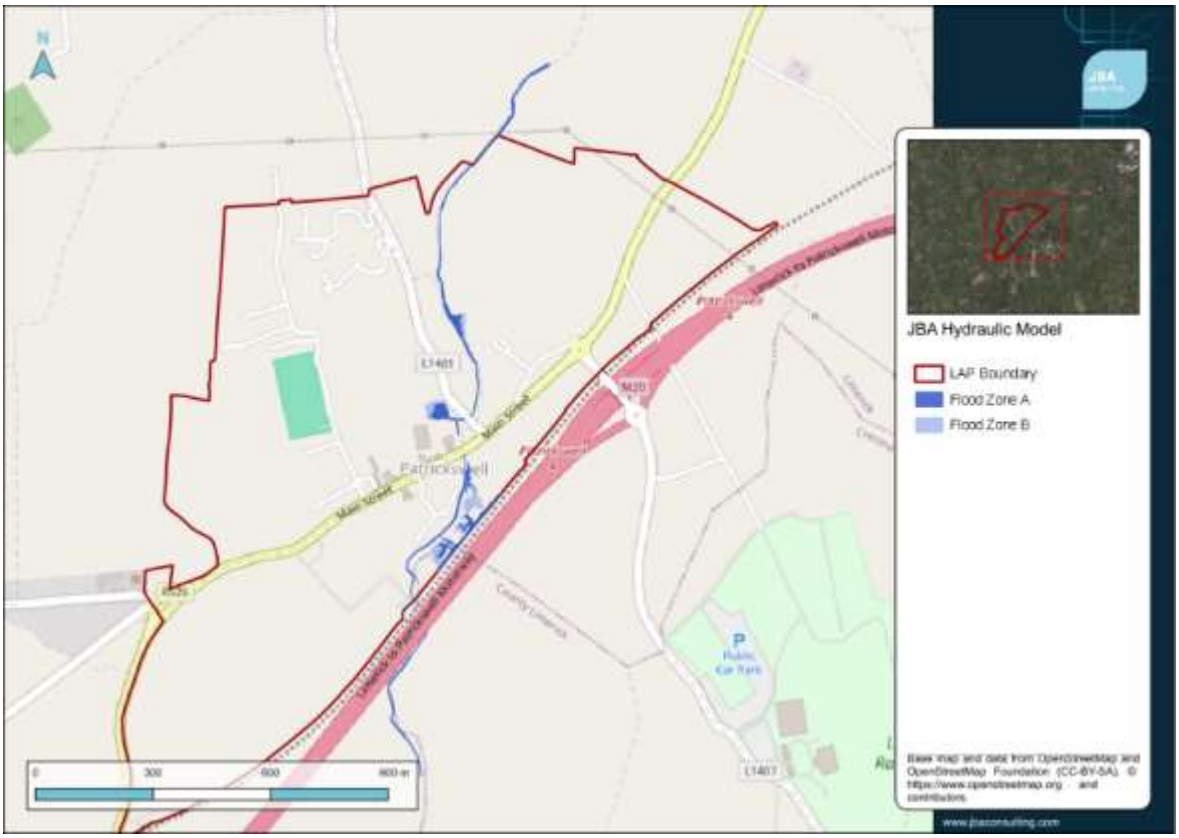


Figure 4-4 JBA Detailed Hydraulic Model

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 Limerick, in recent years. Climate change risks also need to be considered at a strategic and site-specific scale. Climate change is discussed in Section 7 in relation to incorporation of climate change into the SFRA. A comment on the likely impacts of climate change, on a settlement basis, has been provided in Section 8.

5.1 Fluvial Flooding

This is the principal source of flood risk to Patrickswell. Flooding from rivers and streams is associated with the exceedance of channel capacity during times of heavy rainfall resulting in 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.

The River Barnakyle flows to the north and then confluences with the River Maigue further to the northwest of Patrickswell, which then flows towards the Shannon Estuary. The Patrickswell River is also a tributary of the Barnakyle River and borders the very eastern edge of the settlement.

Flood risk relating to specific areas of Patrickswell is discussed in Section 8 and has been used to inform the zoning objectives for the Local Area Plan.

5.2 Tidal Flooding

Patrickswell is located upstream of the Shannon estuary. The Barnakyle is tidally influenced to the north of Patrickswell, therefore the rate of discharge from tributaries in the village may also be affected by the tide. There are however, no reports of flooding due to tidal influence.

5.3 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 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. There are reports of pluvial flooding in Patrickswell, notably in 2020 in which a cemetery flooded due to surface water runoff from a nearby carpark.

5.4 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. The potential for pluvial flooding will be managed by the application of the specific policies on surface water, as displayed in Section 6.

5.5 Arterial Drainage Schemes

Another form of fluvial regime is seen within Patrickswell and this is related to rivers that have been subject to an OPW Arterial Drainage Scheme (ADS). The main purpose of the ADSs was to improve land drainage and reduce the frequency and extent of overland flooding. ADSs can involve embankment construction, river straightening, lake storage development, and, most commonly, the deepening and widening of river channels. Through the implementation of ADSs the hydraulic conveyance efficiency of a catchment is increased, thereby leading to a reduction in overland flood storage. Although it has been found that ADS 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 Maigue Arterial drainage scheme covers the Barnakyle river which joins the Maigue below Ferry Bridge. This tributary runs through an area that is dominated by improved agricultural grassland.
Arterial drainage maintenance and monitoring of the scheme is still carried out by OPW on rivers, lakes, weirs, bridges and embankments to maintain adequate conveyance and 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. For the settlement of Patrickswell on the Maigue Scheme there are lands benefitting from drainage works carried out as part of the scheme.

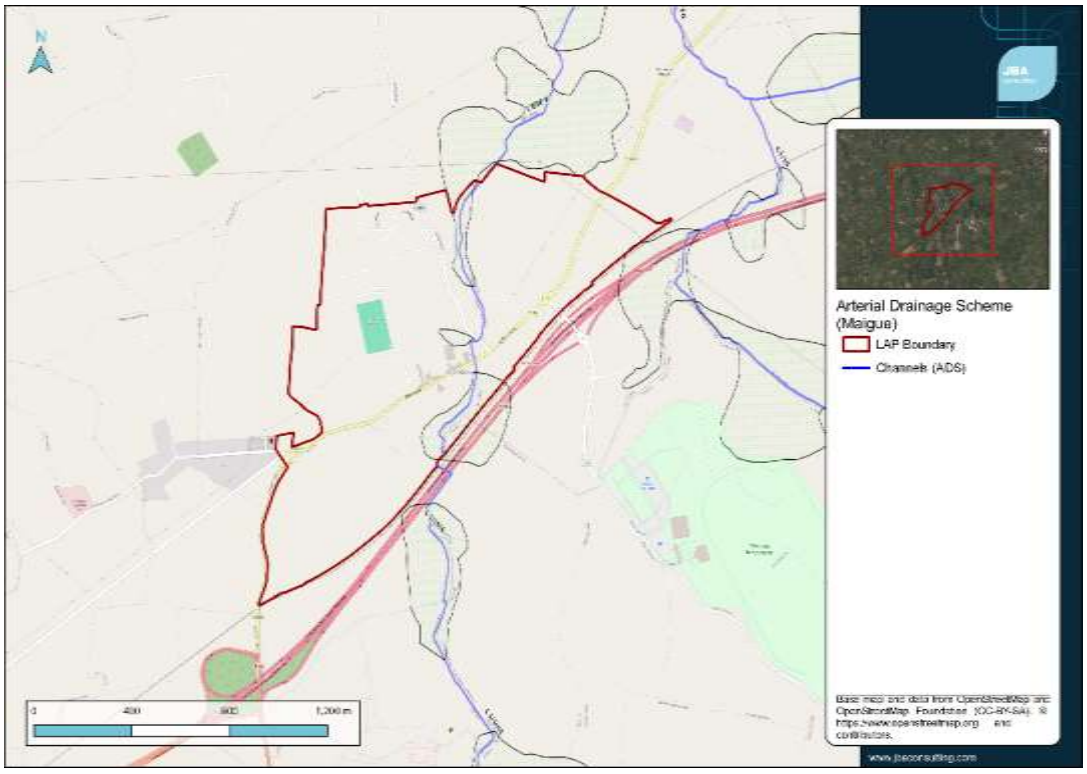


Figure 5-1 Maigue Arterial Drainage Scheme

5.6 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 5.4 and is confirmed that Patrickswell is not at risk from predicted or historic groundwater flooding.

6 Flood Risk Management Policy

The implementation of the Planning Guidelines throughout the county is achieved through the application of the policies and objectives contained within the LDP 2022-2028. Chapter 9 *Climate Action, Flood Risk and Transition to Low Carbon Economy* of the (LDP) sets out the Strategic Aims and key Policy Objectives pertaining to Flood Risk Management in Limerick which includes the Patrickswell LAP area.

The specific management of risk is discussed for each area of Patrickswell in Section 8. Below are policies or objectives from the Draft LAP.

6.1 Flood Risk and Surface Water Policy

IU04	**Surface Water Management and SuDS: It is an objective of the Council to:** a) Maintain, improve and enhance the environmental and ecological quality of surface waters and groundwater, including reducing the discharges of pollutants or contaminants to waters in accordance with the Draft River Basin Management Plan for Ireland 2022-2027 (DHPLG) and associated Programme of Measures.
	b) Require all planning applications to include surface water design calculations to establish the suitability of drainage between the site and the outfall point.
	c) Require all new developments to include Sustainable Urban Drainage Systems (SuDS) to control surface water outfall and protect water quality. Proposals shall have regard to the Nature-based Solutions to the Management of Rainwater and Surface Water Run-off in Urban Areas – Best Practice Interim Guidance' document.
	d) Require applicants to investigate the potential for the provision of porous surfaces, where car parking and hard landscaping is proposed.
	e) Protect the surface water resources of the plan area and in individual planning applications request the provision of sediment and grease traps, and pollution control measures, where deemed necessary.
IU05	**Flood Risk Management: It is an objective of the Council to:** a) Manage flood risk in accordance with the requirements of "The Planning System and Flood Risk Management Guidelines for Planning Authorities", DECLG and OPW (2009) and any revisions thereof and consider the potential impacts of climate change in the application of these guidelines.
	b) Ensure development proposals within the areas outlined as being at risk of flooding are subject to Site Specific Flood Risk Assessment as outlined in "The Planning System and Flood Risk Management Guidelines", DECLG and OPW (2009). These Flood Risk Assessments shall consider climate change impacts and adaptation measures including details of

	structural and non-structural flood risk management measures, such as those relating to floor levels, internal layout, flood-resistant construction, flood-resilient construction, emergency response planning and access and egress during flood events. Reference shall be made to Section 5.8 requirements of the Flood Risk Assessment in the SFRA of the Limerick Development Plan 2022-2028.
	c) Ensure that future developments in flood prone areas are generally limited to minor developments in line with the Flood Risk Management Guidelines for Planning Authorities and the Circular PL 2/2014.
	d) Demonstrate that future development will not result in increased risk of flooding elsewhere, restrict flow paths, where compensatory storage/storm water retention measures shall be provided on site.
	e) Ensure future development of lands within Flood Risk Zone A/B is in accordance with the plan-making Justification Tests in the SFRA.
	f) Developments on lands benefitting from Arterial Drainage Schemes shall preserve the maintenance and access to these drainage channels. Land identified as benefitting from these systems may be prone to flooding, as such site specific flood risk assessments will be required as appropriate, at planning application stage.
IU06	**Flood Risk and Blue Green Infrastructure - It is an objective of the Council to:** Promote integration and delivery of blue green infrastructure in new developments, public realm and community projects as a means of managing flood risk and enhancing the natural environment.
IU07	**Buffer Zone - It is an objective of the Council to:** Provide an appropriate set back from the edge of watercourses to proposed developments to project the integrity of the Barnakyle River and to ensure infinite access for channel clearing, and/or maintenance. Any proposed development shall have cognisance to the contents of the Inland Fisheries Ireland document 'Planning for Watercourses in Urban Environments' and in addition allow for access to and maintenance of existing Irish Water Infrastructure such as outfalls or pipelines.

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 7 should be reviewed for specific recommendations for individual areas of Patrickswell, including details of the application of the Justification Test and the specific requirements within each area of the settlement.

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

An appropriately detailed flood risk assessment will be required in support of any planning application. The level of detail will vary depending on the risks identified and the proposed land use. 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, including groundwater flooding and/or flooding associated with stormwater deficiencies, restrictions or blockages.

For sites within Flood Zone A or B, 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 a 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.

If any un-modelled watercourses are detected on a site and flood risk has consequently not been mapped under the SFRA, it does not mean there is no flood risk present. Instead, a site-specific flood risk assessment of appropriate level of detail should be carried out to delineate the Flood Zones and/or suitable mitigation measures (such as finished floor levels). In such locations the Justification Test has not been applied, so development must progress in accordance with the sequential approach and avoid Flood Zone A and B.

7.2 Development in Flood Zones A or B

7.2.1 Minor Developments

Section 5.28 of the Planning Guidelines on Flood Risk Management identifies certain types of development as being 'minor works'. Applications for minor development, such as small extensions to houses, and most changes of use of existing buildings and or extensions and additions to existing commercial and industrial enterprises, are unlikely to raise significant flooding issues, unless they obstruct important flow paths, introduce a significant additional number of people into flood risk areas or entail the storage of hazardous substances. In these cases, where existing buildings are concerned, the sequential approach cannot be used to locate these minor developments 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 existing residential buildings within Flood Zone A or B, bedroom accommodation shall not generally 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 Limerick City and County Council prior to submission of a planning application.

7.2.2 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 Local Area 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 generally be permitted at basement or ground floor.

7.2.3 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 Limerick City and County Council engineers and planners. However, in Limerick there are limited locations where formal (non-agricultural) flood defences are present.

7.3 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 an appropriate elevation above 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 7.5.

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 7.7.

7.4 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.

7.5 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. Limerick City and County 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.

7.6 Requirements for a Flood Risk Assessment

An appropriately detailed flood risk assessment in accordance with The Planning and Flood Risk Management Guidelines for Planning Authorities, published by the then Department of Environment, Heritage and Local Government, 2009, 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 Limerick City and 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 Limerick City and 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.

7.6.1 Development in Defended Areas

Patrickswell is not defended by any OPW embankments, but the River Barnakyle is known as channel C1/10/4 under the Maigue Arterial Drainage scheme, in this case the channel capacity has been increased to typically cater for the 1 in 30 year event and the channel is maintained by the OPW. The OPW Arterial Drainage Schemes were designed to improve land for agriculture and the lands which may benefit are referred to as 'benefitting lands'. This is not the same as lands that benefit from flood defences, as defined and discussed in the next paragraph.

Benefited lands as part of the Arterial drainage scheme refers to lands that are drained or improved by the arterial drainage scheme. This includes works for the protection of land from flooding and can comprise of drains, embankment, sluices, sluice-gates, pumps, weirs, watercourses, and other works. The scheme was designed to improve land for agricultural use, and therefore, benefitted lands are usually to an agricultural standard. 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 Limerick City and County Council. Informal defences, which may only be at an agricultural standard (such as ADS benefitted lands), 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.

The assessment of breach within the scope of a site specific FRA should be proportionate to the likelihood of the defence failing, taking into account the age, maintenance regime, construction type and the presence of any demountable or mechanically operated components. Proximity of the site to the defence and location within the floodplain will also influence the impact of defence breach and overtopping. Defence overtopping during events which exceed the design standard of protection also

present a risk to developments and should be addressed regardless of the likelihood of the defence breaching.

There are a number of ways in which breach and overtopping of defences can be investigated, depending on the scale of risk and the nature of the development. Prior to undertaking breach analysis, Limerick City and County Council should be consulted to agree the approach taken.

- As the various flood relief schemes progress across the county, breach modelling may also become available which can be used for the purposes of site specific flood risk assessment. As with the CFRAM outputs though, this may not represent the most appropriate location to the site in question.
- Projection of instream water levels across the floodplain – this approach provides a conservative (worst case) estimate of flood risk in the event of defence breach or overtopping as, in reality, water levels across the flood plain would be lower than in the channel. This means the resulting mitigation may be more significant (for example, in terms of ground levels proposed) than if a more detailed modelling approach was taken, particularly if the proposed development site is on the edge of the inundation area. However, in some locations, particularly where a site is partially or fully within Flood Zone A, and /or close to the defence, this conservative approach may be more appropriate.
- Breach modelling – for more complex and higher value developments, bespoke breach modelling can be undertaken in which the overtopping or breach of a flood defence, or failure to install sections of demountable defences can be investigated with specific reference to a development site. The breach modelling may need to be informed by a detailed understanding of the structural condition of the defence, or an understanding of where the demountable defence section is. Breach modelling will also allow a site specific assessment of finished floor levels to be developed, which may be lower than the default standard. The OPW's Guidance on breach modelling, or other best practice guide, should be referenced and an approach agreed with Limerick City and County Council.

The decision as to which approach is most appropriate to the development, and how this information should be used to inform the development design should be made in conjunction with Limerick City and County Council.

7.6.2 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 should be carried out by an appropriately qualified expert with relevant FRA experience (as deemed acceptable by the Planning Authority), in accordance with the Limerick City and County Council SFRA and The Planning System and Flood Risk Management Guidelines.
- Demonstration that the specific objectives or requirements for managing flood risk set out in Section 6 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.

7.7 Climate Change

Ireland's climate is changing and analysis of the potential impacts of future climate change is essential for understanding and planning. Climate change should be considered when assessing flood risk and in particular residual flood risk. Areas of residual risk are highly sensitive to climate change impacts as an increase in flood levels will increase the likelihood of defence failure.

The Planning Guidelines recommend that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. Specific advice on the expected impacts of climate change and the allowances to be provided for future flood risk management in Ireland is given in the OPW Climate Change Sectoral Adaptation Plan[2]. However, this guidance is over 10 years old now and climate science, particularly in relation to sea level rise, has developed rapidly. There are many coastal related climate change impacts, these include:

- continued sea level rise;
- potentially more severe Atlantic storms, which could generate more significant storm surges and extreme waves;
- increased water depths lead to larger waves reaching the coast.

The OPW guidance recommends that two climate change scenarios are considered. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). In all cases, the allowances should be applied to the 1% AEP fluvial flows. Where a development is critical or extremely vulnerable the impact of climate change on 0.1% AEP flows should also be tested.

These climate change allowances are particularly important at the development management stage of planning and will ensure that proposed development is designed and constructed according to current local and national Government advice.

Further work on the impacts of climate change on flood levels was undertaken as part of the Shannon CFRAM Study and the ICPSS/ICWWS/NCFHM. The studies provided flood extents for both fluvial and coastal risk, which are available on www.floodinfo.ie.

Assessment of climate change impacts can be carried out in a number of ways. For watercourses that fall within the Shannon CFRAM study area, flood extents and water levels for the MRFS and HEFS have been developed. For other fluvial watercourses a conservative approach would be to take the 0.1% AEP event levels and extent as representing the 1% AEP event plus climate change. Where access to the hydraulic river model is readily available a run with climate change could be carried out, or hand calculations undertaken to determine the likely impact of additional flows on river levels. In a coastal or tidal scenario, a 0.5m for MFRS or 1m for HEFS plus allowance for land movement, increase to the 0.5% AEP sea level can be assessed based on topographic levels.

---

2 OPW Climate Change Sectoral Adaptation Plan, Flood Risk Management, 2019

The JBA fluvial outlines for the 1%+Climate Change show moderate to high sensitivity to climate change within Patrickswell village. JBA mapping illustrating the 1% and 1% AEP plus climate change (HEFS) is seen in Figure 7-1 and 0.1% and 0.1% plus climate change (HEFS) in Figure 7-2. Climate Change is specifically reviewed for each area within the settlement under Section 8 and directly impacts land use zoning decisions and finished floor level requirements in Patrickswell.

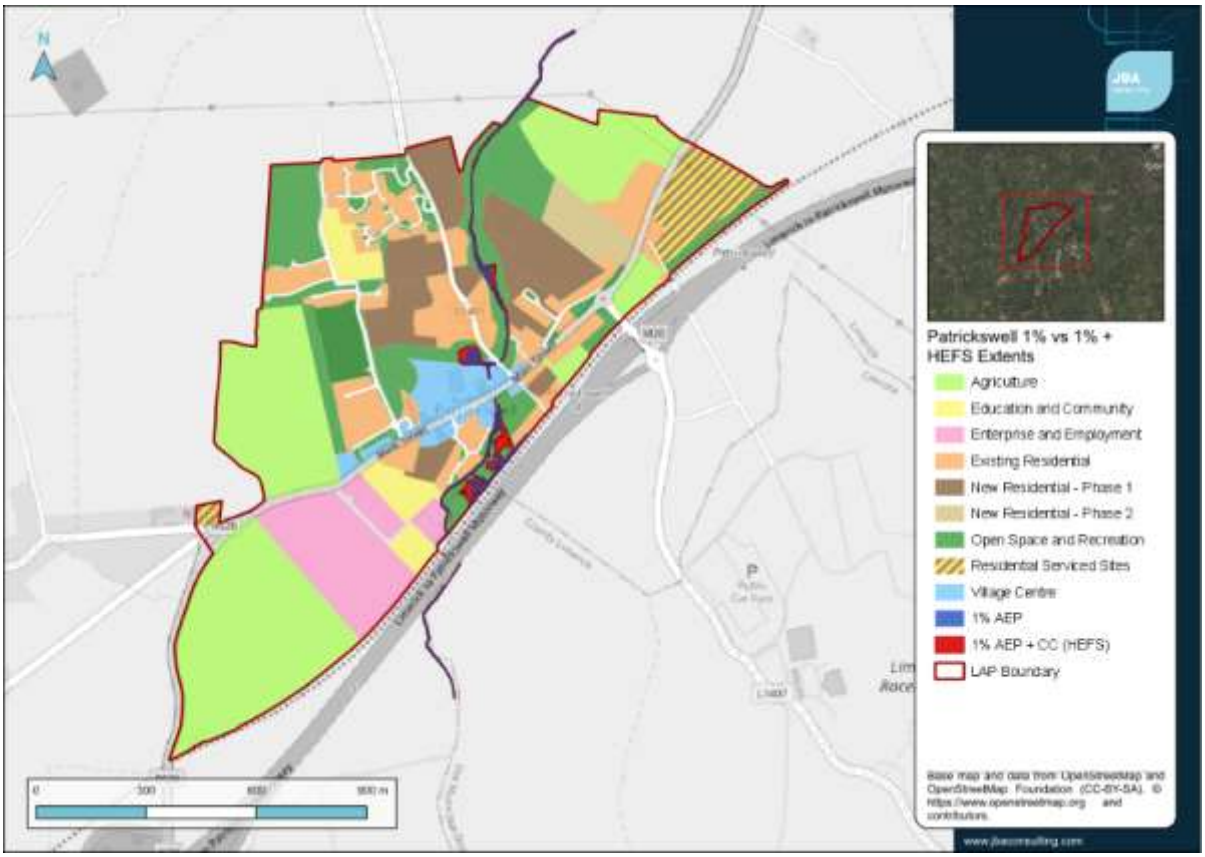


Figure 7-1 JBA mapping, 1% vs 1% Climate Change (HEFS)

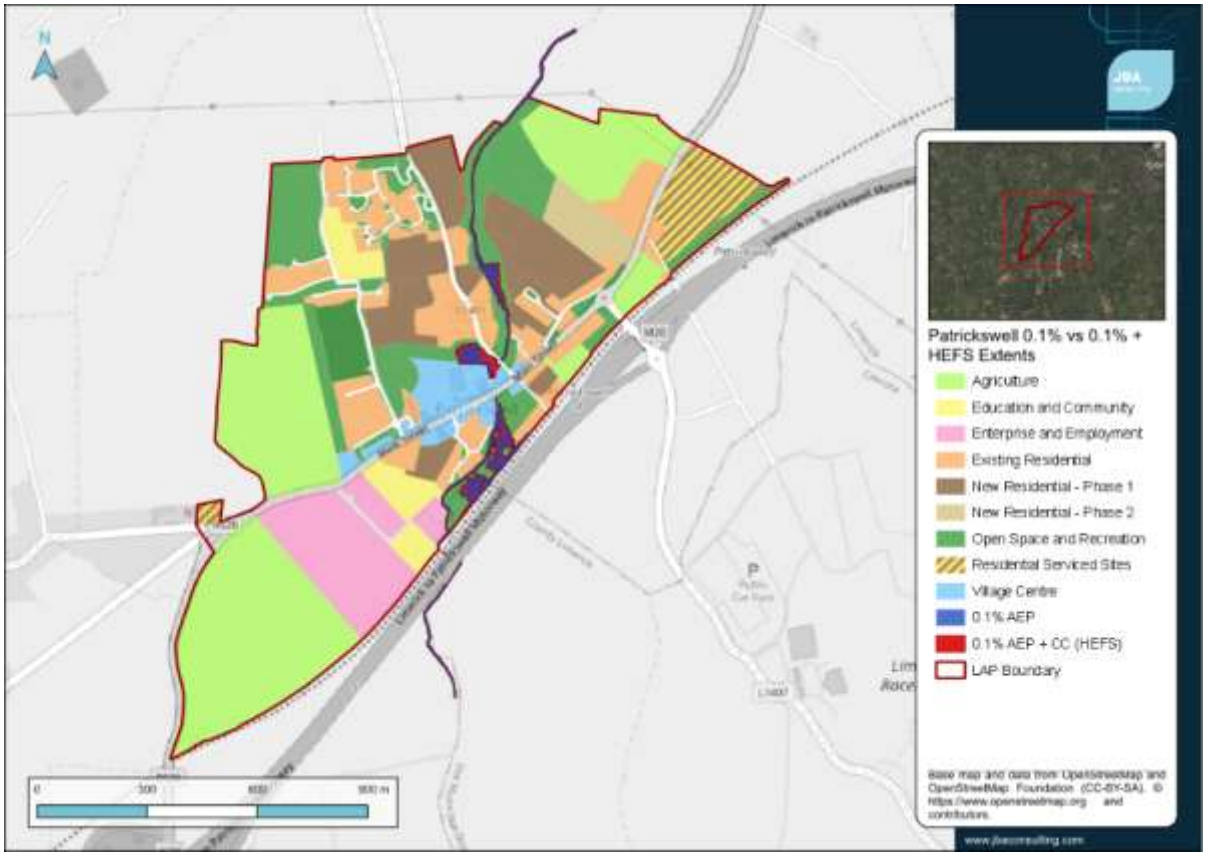


Figure 7-2 JBA mapping, 0.1% vs 0.1% Climate Change (HEFS)

Table 7-1: Climate change allowances by vulnerability and flood source

Development vulnerability	Fluvial climate change allowance (increase in flows)	Tidal climate change allowance (increase in sea level)	Storm water / surface water
Less vulnerable	20%	0.5m (MRFS) + 50mm for land movement	The Surface water management plan including details of climate change allowances is under preparation
Highly vulnerable	20%	0.5m (MRFS) + 50mm for land movement	
Critical or extremely vulnerable (e.g. hospitals, major sub-stations, blue light services)	30%	1.0m (HEFS) + 50mm for land movement	
Note: There will be no discounting of climate change allowances for shorter lifespan developments.			

7.8 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, it must be demonstrated that appropriate mitigation measures can be put in place and that residual risks can be managed to acceptable levels. Guidance on what might be considered 'acceptable' has been given in a number of sections in this document.

To ensure that adequate measures are put in place to deal with residual risks, proposals should demonstrate 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[3].

It should be emphasised that measures such as those highlighted below should only be considered once it has been deemed 'appropriate' to allow development in a given location. The Planning Guidelines do not advocate an approach of engineering solutions in order to justify the development which would otherwise be inappropriate.

7.8.1 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, recreational space can be located in higher flood risk areas. Highly vulnerable land uses (i.e. residential housing) should be substituted with less vulnerable development (i.e. retail unit).

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.

7.8.2 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 particular site in question. However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced locally and could have an adverse effect on 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.
- Compensatory storage should be provided on a level for level basis to balance the total volume that will be lost through infilling where the floodplain provides static storage. There should be no overall loss of floodplain storage volume as a result of the development in the 1% AEP event and impacts of the amended storage should be tested for the 0.1% AEP event to ascertain no significant increase in risks associated with the extreme event.
- 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 land being given over to storage must be land which does not flood in the 1% AEP event (i.e. Flood Zone B or C).

---

3 The Planning System and Flood Risk Management Guidelines for Planning Authorities, Technical Appendices, November 2009

- The compensatory storage area should be constructed before land is raised to facilitate development. This is to ensure no temporary loss of flood storage volume during construction.

In some sites it is possible that ground levels can be re-landscaped to provide a sufficiently large development footprint within Flood Zone C. 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 means 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. Finished floor levels should be assessed in relation to the specific development, but the minimum levels set out in Table 7-2 should apply. It should be noted that in certain locations it may be appropriate to adopt a more precautionary approach to setting finished floor levels, for example where residual risks associated with bridge blockage occur, and this should be specifically assessed in the FRA. In other locations detailed modelling may demonstrate a lower finished floor level is acceptable; this should be discussed with Limerick City and County Council on a case by case basis. It is also noted that typically finished floor levels should be set a minimum of 300mm above surrounding ground levels to prevent ingress of surface water.

Table 7-2: Recommended minimum finished floor levels

Scenario	Finished floor level to be based on
Fluvial, undefended	1% AEP flood + climate change (as Table 7-1) + 300mm freeboard.
Fluvial, defended	1% AEP flood + 300mm freeboard. Climate change does not need to be included, provided it is included in the defence height or adaption plan for the scheme. Where a breach model has been developed to further understand risks, FFL may be set based on model outputs.

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.

7.8.3 Raised Defences

Construction of raised defences (i.e. flood walls and embankments) traditionally has 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.

7.8.4 Flood Resilient and Resistant Development

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

Design can include for wet-proofing of a building to make it flood resilient and reduce the impact of flooding. For example, use of water-resistant materials such as tiles on floors and walls that can be easily washed down and sanitised after a flood event, and the installation of electrical sockets and other circuits at higher levels, with power wires running down from ceiling level rather than up from floor level.

Flood resistance measures can also be incorporated such as the provision of temporary and permanent flood barriers, but would not be considered acceptable as the primary means of managing flood risk. Permanent barriers, in the form of steps (or ramps) at doorways, rendered brick walls and toughened glass barriers, can help prevent flood water entering buildings. Alternatively, temporary barriers can be fitted into doorways and windows, with discrete permanent fixings that keep architectural impact to a minimum. However, flood warning becomes a very important issue when dealing with temporary or demountable defences and such measures are only suitable for relatively shallow depths of flooding. The suitability of temporary defences should be assessed on a case by case basis in conjunction with Limerick City and County Council.

Whilst it may be desirable to retro-fit flood resilience and resistance to an existing development, for example as part of a change of use application, it is often difficult and costly to achieve, with options limited depending on the age and construction of the existing building.

7.8.5 Emergency Flood Response Plans

In some instances, and only when all parts of 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 and emergency plan does not mean this is advisable or appropriate for the nature and vulnerability of development and Limerick City and County Council will not accept an emergency response plan as part of a residential development in isolation or in lieu of appropriate mitigation measures to reduce flood risk to an acceptable standard.

7.9 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 Limerick Development Plan objectives, these include EH O14, CAF O11 and the stormwater objectives that overlap with the LAP under IN O12.

7.10 '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;
- Provides benefit to the ecological functioning of the river system;
- 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 topographical constraints, such as raised land and flood defences, but would ideally span the full 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 Patrickswell 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 Patrickswell 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 basis and with reference to Table 8-1. For example, a town or 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.

8.2 Amenity & Sustainable Transport Routes

A review of amenity and sustainable transport routes detailed in the Local Area Plan has also been carried out as part of this SFRA. Under the Planning Guidelines and Flood Risk Management, such routes can be classed as water compatible whilst local transport infrastructure and essential infrastructure, such as primary transport routes would be classed as less vulnerable and highly vulnerable, respectively.

Limited sections of the pedestrian and cycle routes proposed in Patrickswell are within Flood Zone A/B (see Figure 8-1) and most are existing. As far as the Justification Test applies, there are no alternative routes which are wholly within Flood Zone C and the Test is not applied in this case. Any new walking and cycling routes should not seek to raise ground levels within the Flood Zone. There are no new bridges/structures proposed. Management of stormwater from any new or upgraded routes should follow Objective IU04 with particular note to point c regarding SuDS and Nature Based Solutions.

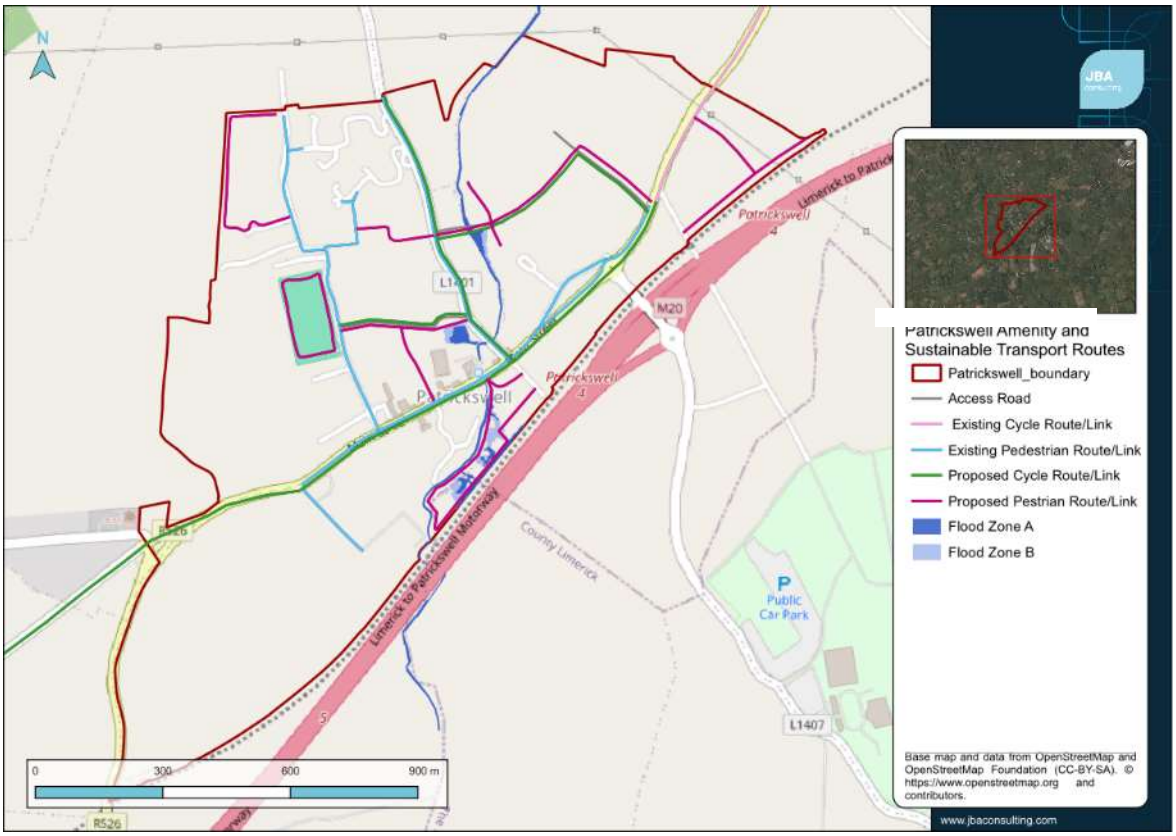


Figure 8-1 Patrickswell Amenity & Sustainable Transport Routes

Table 8-1: Zoning Objective Vulnerability

Zoning Objective	Indicative Primary Vulnerability	Flood Risk Commentary
Agriculture	Water compatible / highly vulnerable	JT not needed, but for new farm housing the sequential approach must apply.
Enterprise & Employment	Less / highly vulnerable	For highly vulnerable development in Flood Zone A or B. For less vulnerable development in Flood Zone A.
Education and Community	Less / highly vulnerable	Consideration to be given to flood risks and sequential use of land to ensure highly vulnerable uses are located within areas at lowest risk of flooding. For highly vulnerable development in Flood Zone A or B. For less vulnerable development in Flood Zone A.
Existing Residential	Highly Vulnerable	JT required for within Flood Zone A and B.
New Residential	Highly Vulnerable	JT required for within Flood Zone A and B.
New Residential Phase 2	Highly Vulnerable	JT required for within Flood Zone A and B.
Residential Serviced sites	Highly Vulnerable	JT required for within Flood Zone A and B.
Open Space and Recreation	Water compatible	For Water Compatible, JT not required. For less vulnerable development in Flood Zone A.
Utilities	Less / highly vulnerable	For highly vulnerable development in Flood Zone A or B. For less vulnerable development in Flood Zone A.
Village Centre	Less / Highly Vulnerable	For highly vulnerable development in Flood Zone A or B. For less vulnerable development in Flood Zone A.

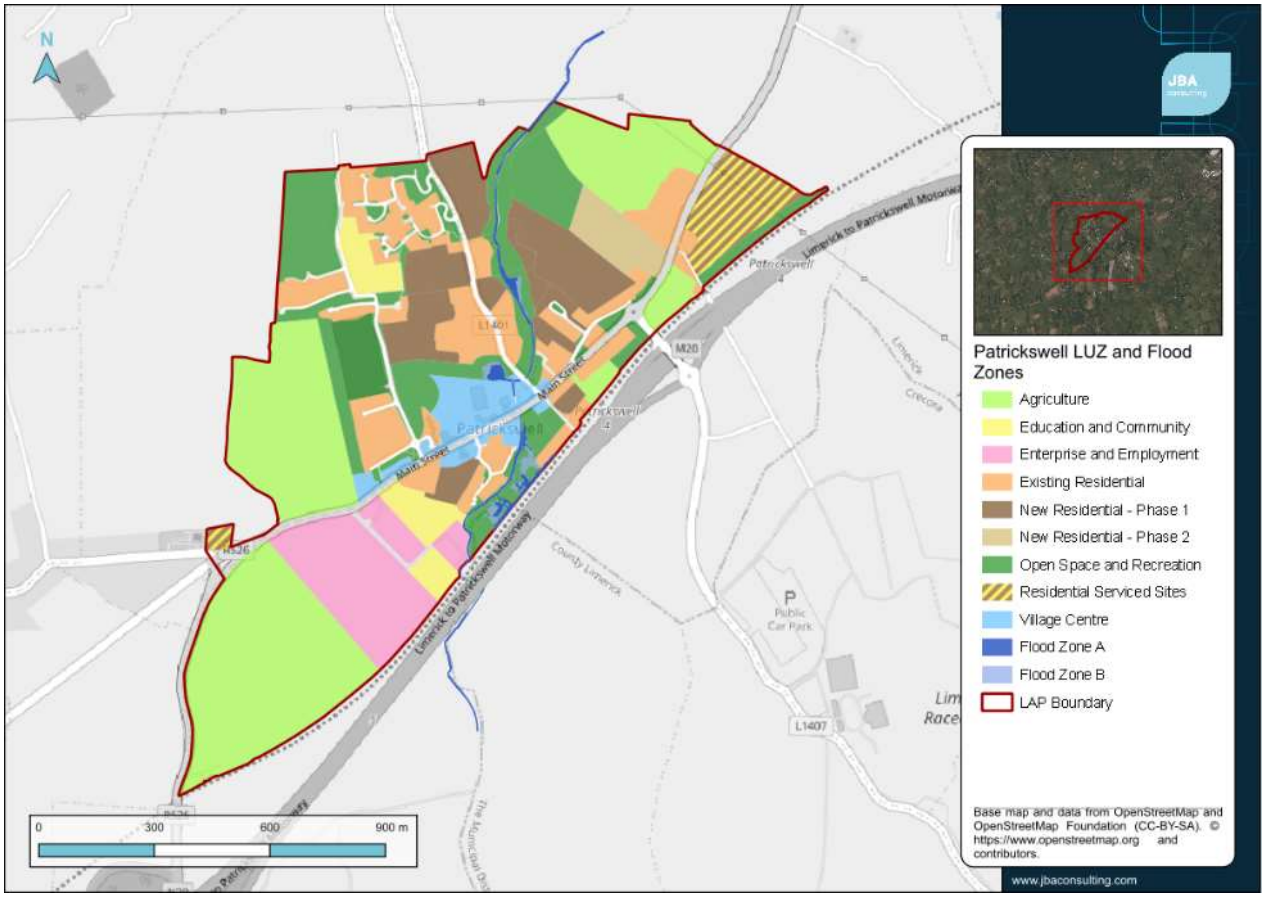
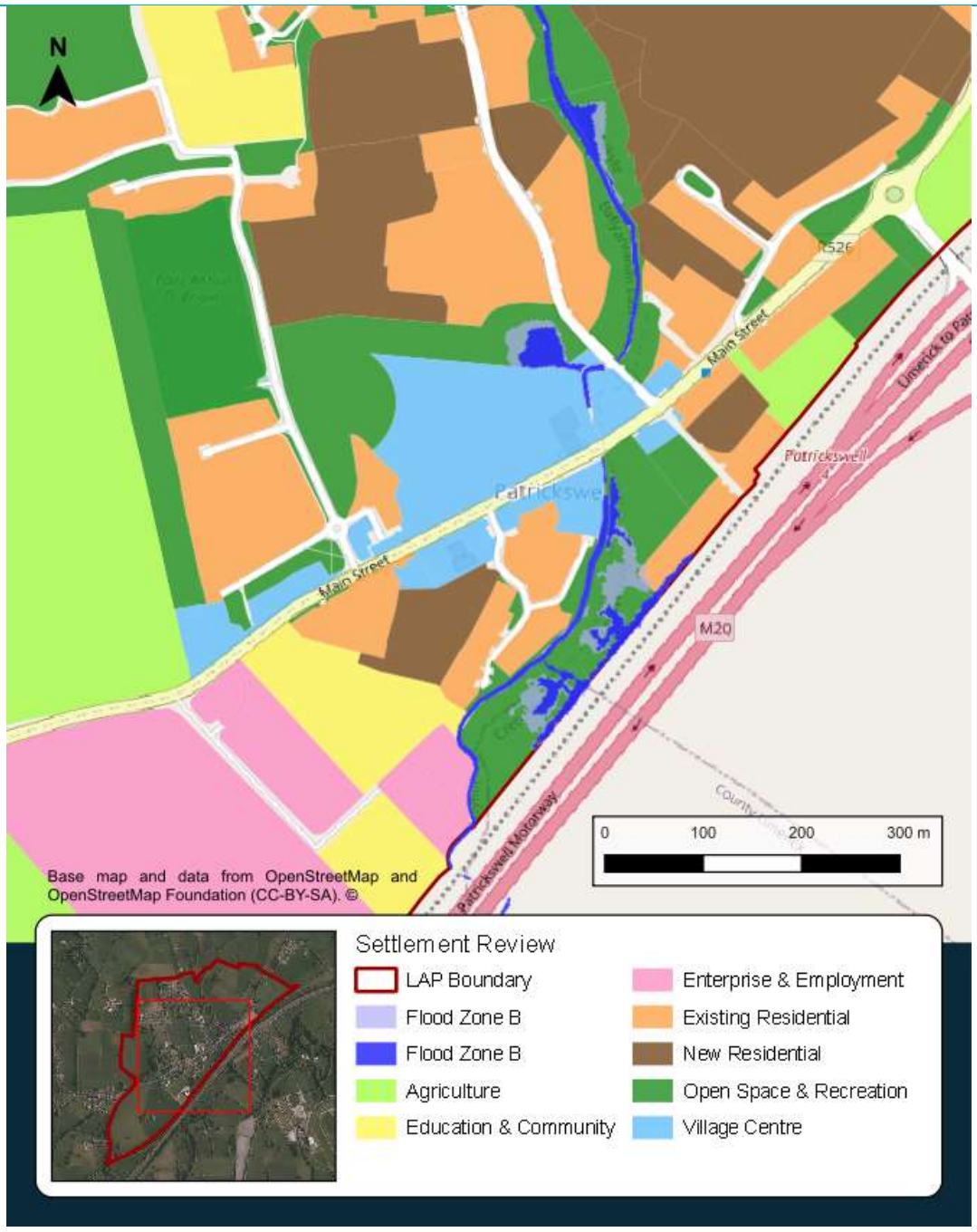


Figure 8-2 Overview Map - Land Use Zoning and Flood Zones

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.

8.3 Patrickswell Village Centre



© OpenStreetMap contributors, CC-BY-SA,

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	JBA detailed hydraulic model
Historic Flooding	Local reports of constricted culverts causing flooding.
Comment	The Barnakyle River, flows through the area in a northerly direction. JBA mapping shows some existing residential and town centre zonings at risk of flooding.
Climate Change	Sensitive to climate change in the 1 in 100yr extents. These largely match with the 1 in 1000 yr extents. The impacts of climate change can be reduced

	through adaptation strategies such has setting appropriate FFLs and proper management of residual risks.
Conclusion	Risk to existing residential and town centre in Flood Zone A and B. Open space and recreation are water compatible and appropriate uses within Flood Zones A and B. The Justification Test has applied and passed for the Town Centre Zoning (see Section 9.1) on the basis that; • Within Flood Zone A/B development is limited to extensions, renovations and change of use. • 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 points listed in Section 9.1 which include; • FRA should address climate change and FFL requirements in relation to Table 7 1 and Table 7 2, where practicable; • FRA should address climate change scenarios in relation to FFLs and potential mitigation measures; • Residual risk of culvert blockage should be assessed; • Bedrooms should be located in the upstairs of two-story buildings when extending existing property. • Demolition/reconstruction consisting of infill residential development on the ground floor can only take place in Flood Zone C. • 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; • Any development shall also be required to be built in accordance with Objective IU04 with particular note to point c regarding SuDS and Nature Based Solutions. Risk to Existing Residential lands can be managed by following the sequential approach and avoiding less or highly vulnerable development in Flood Zone A or B and according to the recommendations contained in section 7 and on the basis that development is; • Limited to extensions, renovations and change of use. • Bedrooms should be located in the upstairs of two-story buildings when extending existing property. • Demolition/reconstruction consisting of infill residential development on the ground floor 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 and FFL requirements in relation to Table 7 1 and Table 7 2, where practicable. Elsewhere in the area, risk can be managed in line with approved Policy and the guidance provided within Section 7 of this SFRA.

8.4 Fortetna

© OpenStreetMap contributors, CC-BY-SA,

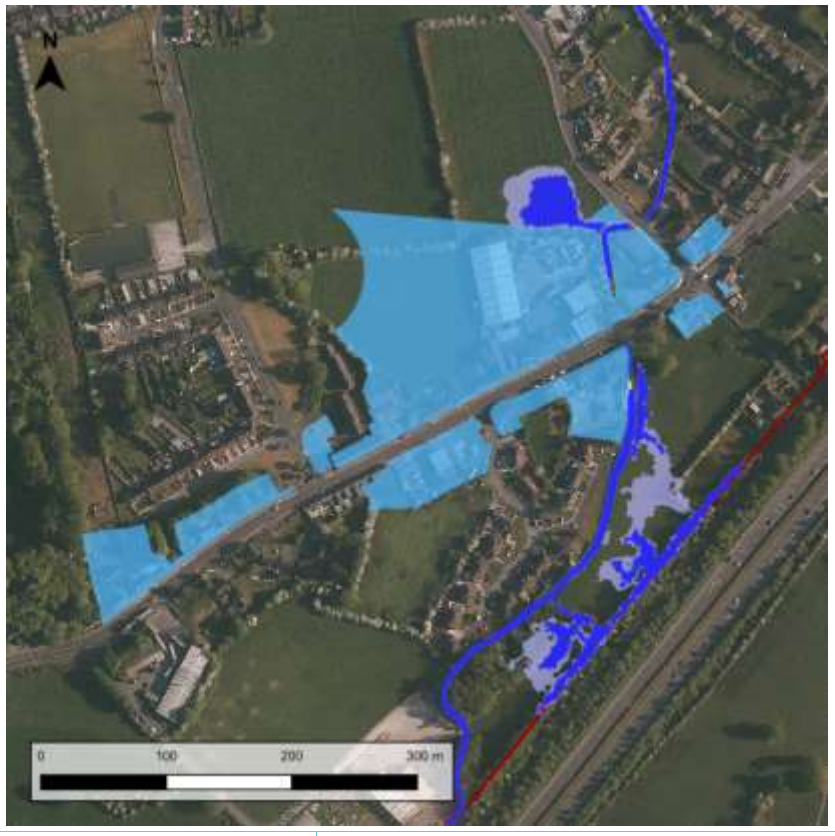
The flood mapping has been produced in accordance with the Planning Guidelines and therefore ignores the impact of flood protection structures. Areas protected by flood defences still carry a residual risk of flooding due to overtopping or breach, there may also be no guarantee of maintenance in perpetuity.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

Flood Zone Data	JBA detailed hydraulic model
Historic Flooding	No reports of fluvial flooding. Some reports of pluvial flooding at cemetery.

Comment	The Barnakyle River, a tributary of the Maigue, flows through the area in a northerly direction, before turning west towards its confluence with the Maigue. JBA mapping shows education and community and enterprise and employment zonings at risk of flooding.
Climate Change	Low sensitivity to climate change.
Conclusion	Open space and recreation are water compatible and appropriate uses within Flood Zones A and B. The limited risk to Education and Community zoning can be managed by following the sequential approach and avoiding less or highly vulnerable development in Flood Zone A or B and according to the recommendations contained in section 7 and on the basis that development within Flood Zone A/B is limited to water compatible use. Risk to enterprise and employment lands can be managed by following the sequential approach and avoiding less or highly vulnerable development in Flood Zone A or B and according to the recommendations contained in section 7 and on the basis that development can only take place in Flood Zone C. Since these lands are undeveloped it is a suitable opportunity to apply nature based surface water management in line with Objective IU04 (c) and the DHLGH Best Practice 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 approved Policy and the guidance provided within Section 7 of this SFRA.

9 Justification Tests

9.1 Patrickswell Village Centre



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.	In line with National Policy Objective 3a of the NPF, which requires the delivery at least 40% of all new homes nationally, within the built-up footprint of existing settlements, the Limerick Development Plan 2022- 2028 set out a settlement hierarchy for the city and county. Patrickswell is a Level 4 Settlement in the settlement hierarchy, identified in the Limerick Development Plan 2022 – 2028. The Limerick Development Plan promotes Level 4 settlements, as development centres for population growth sustaining a wide range of functions, services and employment opportunities supporting its hinterland. In line with National Policy Objective 3c, 30% of all new homes targeted within Level 4 settlements shall be within the existing built-up area of the village. In addition and as is set out under the Regional Spatial and Economic Strategy for the Southern Region (RSES), Patrickswell forms part of the Limerick Shannon Metropolitan Area and comes within the scope of the Limerick Shannon Metropolitan Area Strategic Plan (MASP). The Limerick Shannon Metropolitan Area is targeted for growth under the NPF and RSES. The MASP seeks to strengthen the role of the Metropolitan Area as an international location of scale and a primary driver of economic and population growth in the Southern Region. Part of the lands within the village centre, are identified as being at risk of flooding, however, the lands are

	predominantly developed and also form the core of the village and in line with national, regional and local planning policy will facilitate consolidation of the village core through the development by in large of brownfield or infill lands.
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 lands are proposed to be zoned village centre, reflecting their existing central location within the settlement. The lands at risk of flooding comprise a sliver between an existing hard surfaced yard and greenfield site. The lands are essential to facilitate compact growth, regeneration and expansion of the centre of the settlement.
ii. Comprises significant previously developed and/or under-utilised lands:	These village centre lands are significantly under-utilised.
iii. Is within or adjoining the core of an established or designated urban settlement:	The lands are located within the core of the village.
iv. Will be essential in achieving compact and sustainable urban growth;	Any development on these lands will contribute to compact urban growth aligned to higher-level spatial policy.
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.	There are no alternative lands closer to the centre of the village.
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 village centre are within Flood Zone A/B, most of the land is under existing development. Parts 1 and 2 of the test found that it is considered appropriate to retain the existing zoning. This is on the basis that; • Within Flood Zone A/B development is limited to extensions, renovations and change of use. • Demolition/reconstruction consisting of infill residential development on the ground floor can only take place in Flood Zone C. • Less vulnerable development is appropriate within Flood Zone 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 following: • FRA should address climate change and FFL requirements in relation to Table 7-1 and Table 7-2 where practicable; • Bedrooms should be located in the upstairs of two-story buildings when extending existing residential property in Flood Zone A/B; • Flood resilient construction materials and fittings

	should be considered if in Flood Zone A/B; • Residual risk of culvert blockage should be assessed; • 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 Objective IU04 with particular note to point c regarding SuDS and Nature Based Solutions.