Chapter 16
Water

N25 Little Island Pedestrian and Cyclist Bridge
Environmental Impact Assessment Report

Appendix 16.1

Flood Risk Assessment

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1. Introduction

Arup has been appointed by Cork County Council (CCC) to undertake a site-specific Flood Risk Assessment (FRA) which forms part of planning application for the proposed new N25 Little Island Pedestrian and Cyclist Bridge (i.e., the Proposed Development). The Proposed Development is located approximately 10km to the east of Cork City. The FRA has been undertaken in accordance with 'The Planning System and Flood Risk Management' Guidelines for Planning Authorities published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage, and Local Government (DEHLG) and Circular PL 2/2014, hereafter referred to as 'the Guidelines'. The purpose of the study is to identify and quantify the risk of flooding to the Proposed Development and elsewhere, and identify any measures, if required, to mitigate the risk.

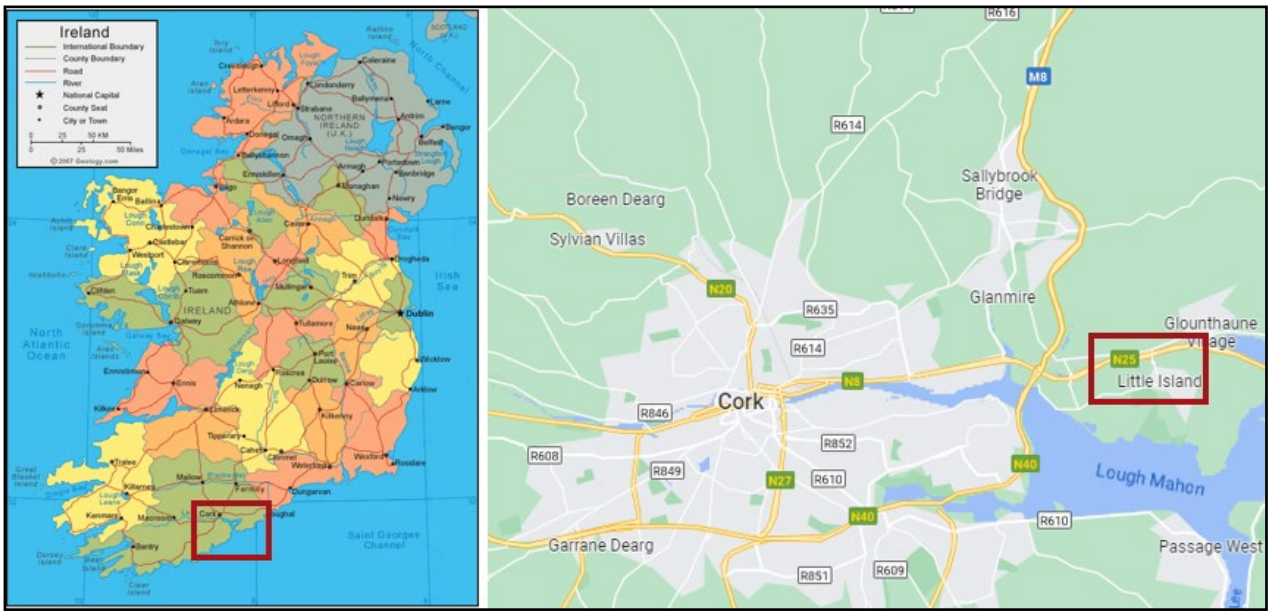

Image 1.1: Approximate Site Location

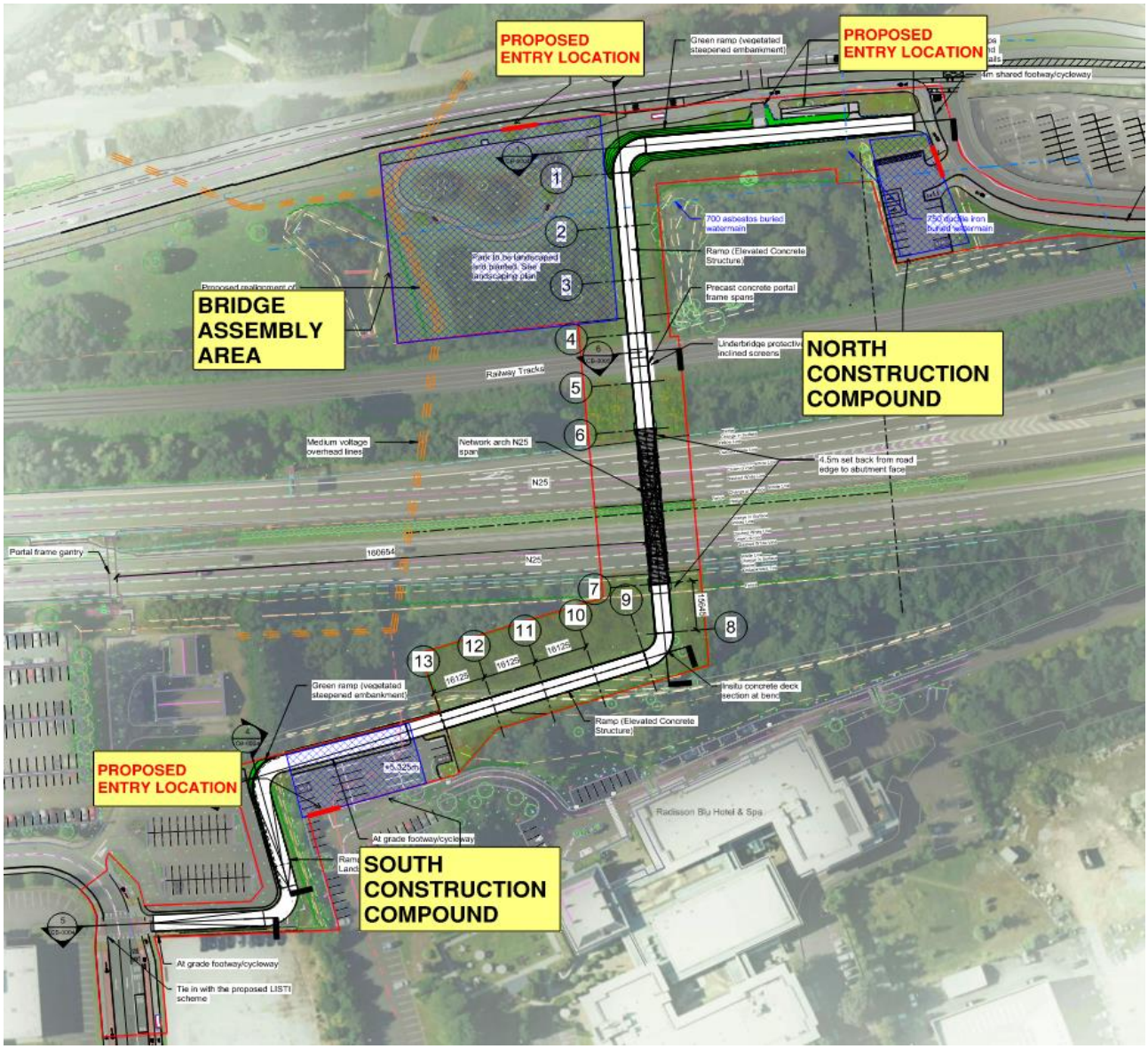

Image 1.2: Extract of Proposed Development site layout, illustrating proposed construction compounds and bridge assembly compound.

1.1 Proposed Development Overview

The Proposed Development will consist of a new pedestrian and cyclist bridge that encompasses a segregated footway and cycleway that will be 5m wide (3m two-way cycleway and 2m footway), connecting the Little Island Train Station and the Dunkettle to Carrigtwohill pedestrian and cycle route with the Radisson Blu Hotel, Eastgate Business Park and the wider surrounds of Little Island. The proposed structure consists of a single span (approximately 49m) steel network arch structure over the N25, a 2 x 15m span precast segmental portal frame structure over the Irish Rail line, and access ramps to the north and south sides. The bridge will have a minimum vertical clearance of 5.7m over the road and 5.3m over the railway line and a maximum slope of 1:22 on the approach ramps, as shown in **Image 1.3**.

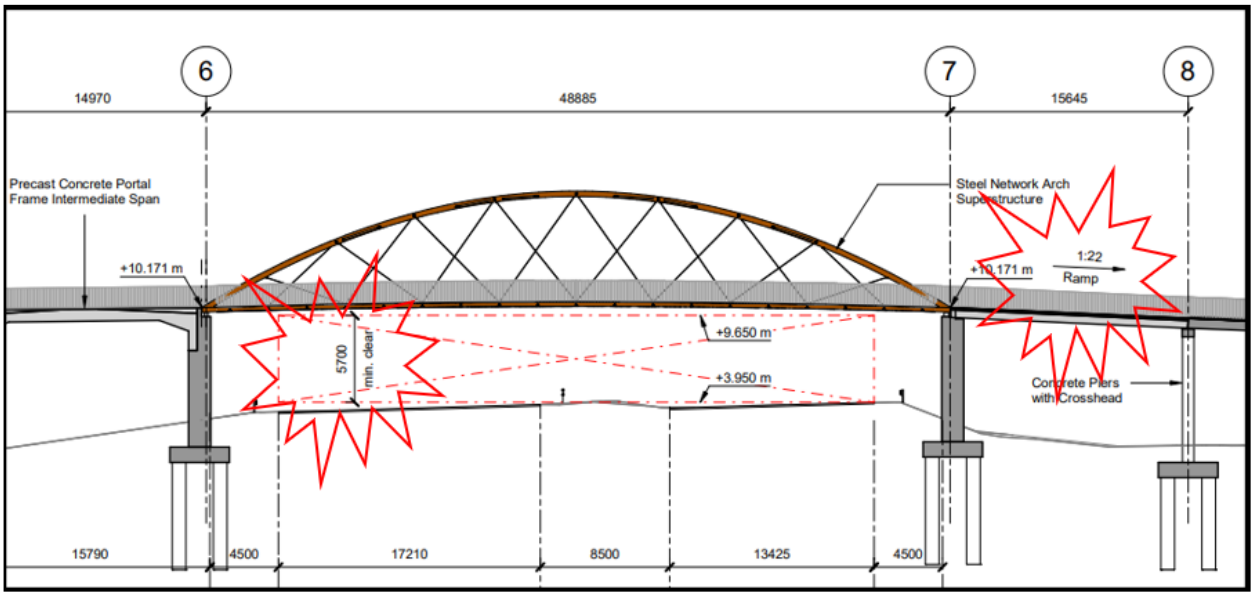

Image 1.3: Cross section of Bridge over the road showing vertical clearance and maximum slope.

1.2 Scope of the Study

The scope of the study includes the following:

- Review of all relevant information and data from:
  - South Western Catchment Flood Risk Assessment and Management Study (CFRAMS);
  - The Office of Public Works (OPW) Preliminary Flood Risk Assessment Mapping (PFRA);
  - The Irish Coastal Protection Strategy Study (ICPSS);
  - Historic flooding information for the area and / or any relevant studies; and
  - Available topographical information for the site.
- Review of the risk of coastal, fluvial, pluvial and groundwater flooding; and
- Preparation of a flood risk assessment report.

1.3 Summary of Data Used

In preparing this report, the following data was collated and reviewed:

- Flood history of the site from OPW National Flood Hazard Mapping website (www.floodmaps.ie);
- CFRAM mapping produced by OPW (www.floodinfo.ie);
- Guidelines for Planning Authorities on 'The Planning System and Flood Risk Management' published in November 2009, jointly by the OPW and the then DEHLG;
- Preliminary Flood Risk Assessment (PFRA) mapping produced by the OPW (www.cfram.ie/pfra);
- Site geological and hydrogeological data from the Geological Survey of Ireland website (www.gsi.ie); and
- Aerial photography and mapping from Google Maps.

Note that all Ordnance Datum (OD) levels referred to in this report are to Malin Head.

2. Stage 1 – Flood Risk Identification

In this stage, all flooding and surface water issues that might affect the site are assessed to confirm if the site is at risk of flooding from all known sources.

2.1 Historic Flooding at the Site

Records of historic fluvial flooding near the Proposed Development site were reviewed from the OPW National Flood Hazard Mapping website (www.floodinfo.ie). An extract from the website is included in **Image 2.1**. The map shows no historic record of flooding at the site. The flooding incident shown on the map (within circle) at Wexford Street on 26th October 2004 (approximately 2km) was due to coastal / estuarine waters. It should be noted that an absence of a historic record of flooding at the site of interest may not mean that the site is not at risk of flooding.

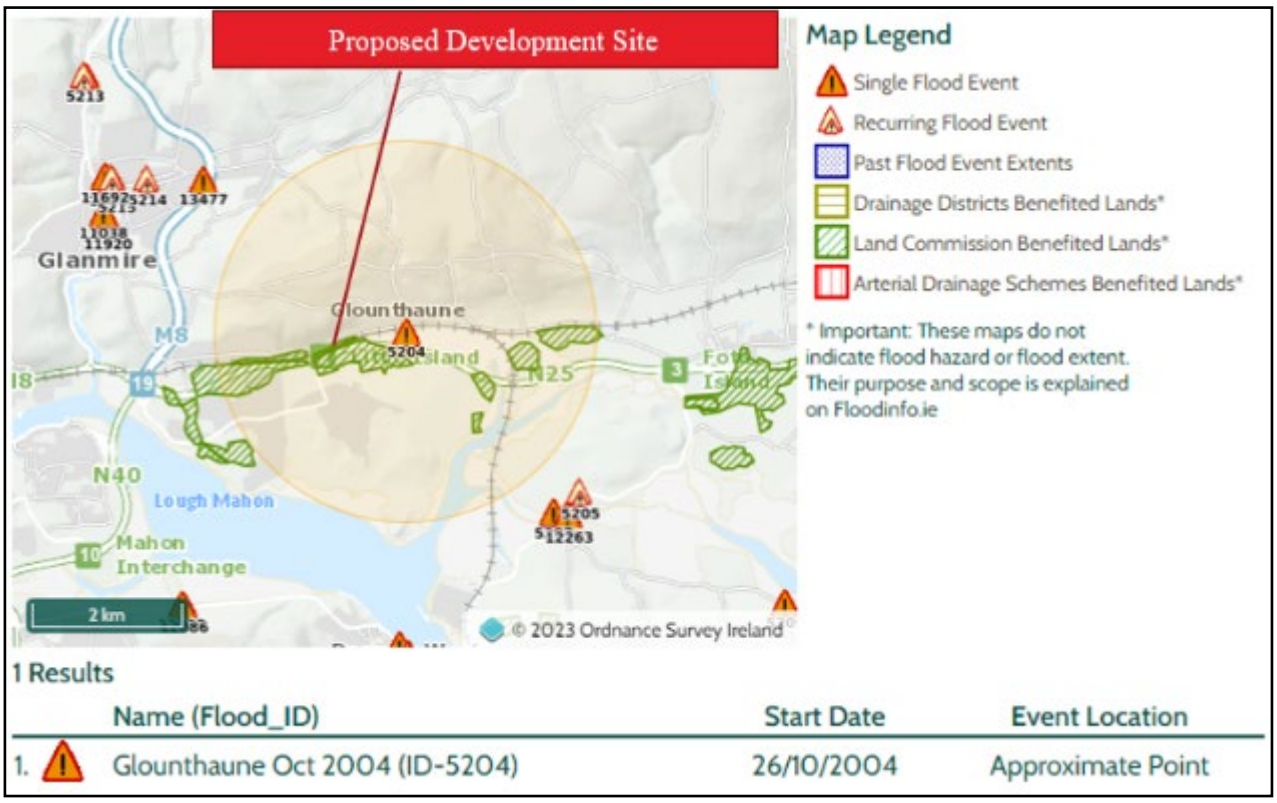

Image 2.1: Historical Flooding at Proposed Development Location (source: www.floodinfo.ie)

2.2 Fluvial Flooding

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains).

Image 2.2 shows the CFRAM flood maps for the 0.1%, 1% and 10% AEP fluvial floods. It can be seen from the flood extents that the Proposed Development is located outside of the flood extents and is therefore at low risk of fluvial flooding.

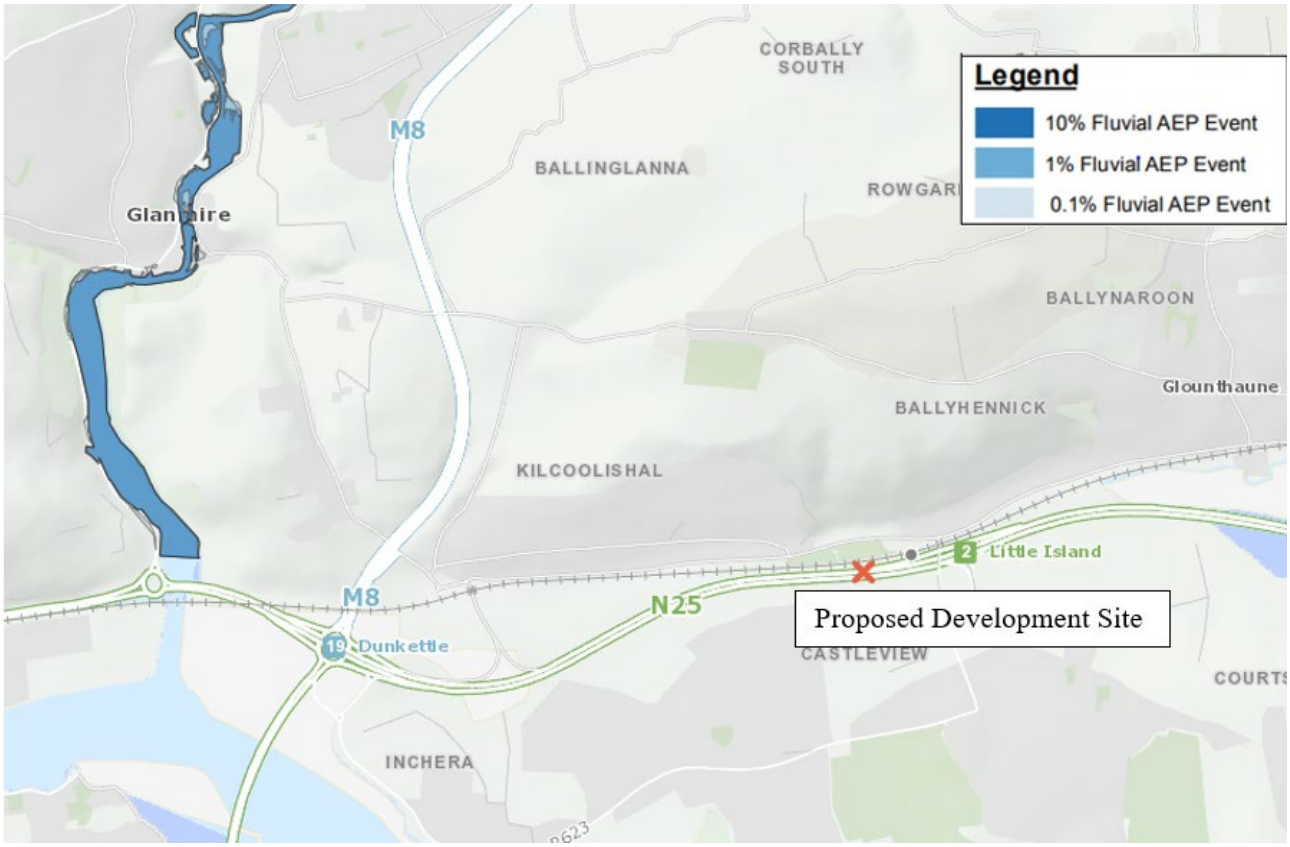

Image 2.2: Extract from South Western CFRAMS fluvial flood extents, current scenario (source: www.floodinfo.ie)

The only other surface water body that appears to interface with the Proposed Development site is the Kilcoolishal Stream that drains the marshy area north of the N25 and south of the railway line, before discharging to Cork Harbour via Eastgate Business Park (culverted). There is neither a historical record nor any flood maps that indicate flooding to the Proposed Development site because of this stream.

2.3 Coastal Flooding

An extract from the South Western CFRAM Study coastal flood extents is presented in **Image 2.3**. The predicted extent for the 1 in 10-, 200- and 1000-year fluvial flood events are shown. The Proposed Development location lies within the 0.5% AEP coastal floodplain (within Flood Zone A) on the northern access ramp. and is therefore at risk of coastal flooding.

The Cork County Development Plan Mapper 2022-2028 (CCC, 2022) also identifies a flood risk to the south of the N25. However, the Proposed Development location lies outside of the 0.5% AEP coastal floodplain (within Flood Zone C) on the southern access ramp. Hence, the southern access ramp is under low risk. Refer to **Image 2.4**.

It is noted that tidal flooding encroaches the Proposed Development site from the east to the west after inundating Harper's Island first.

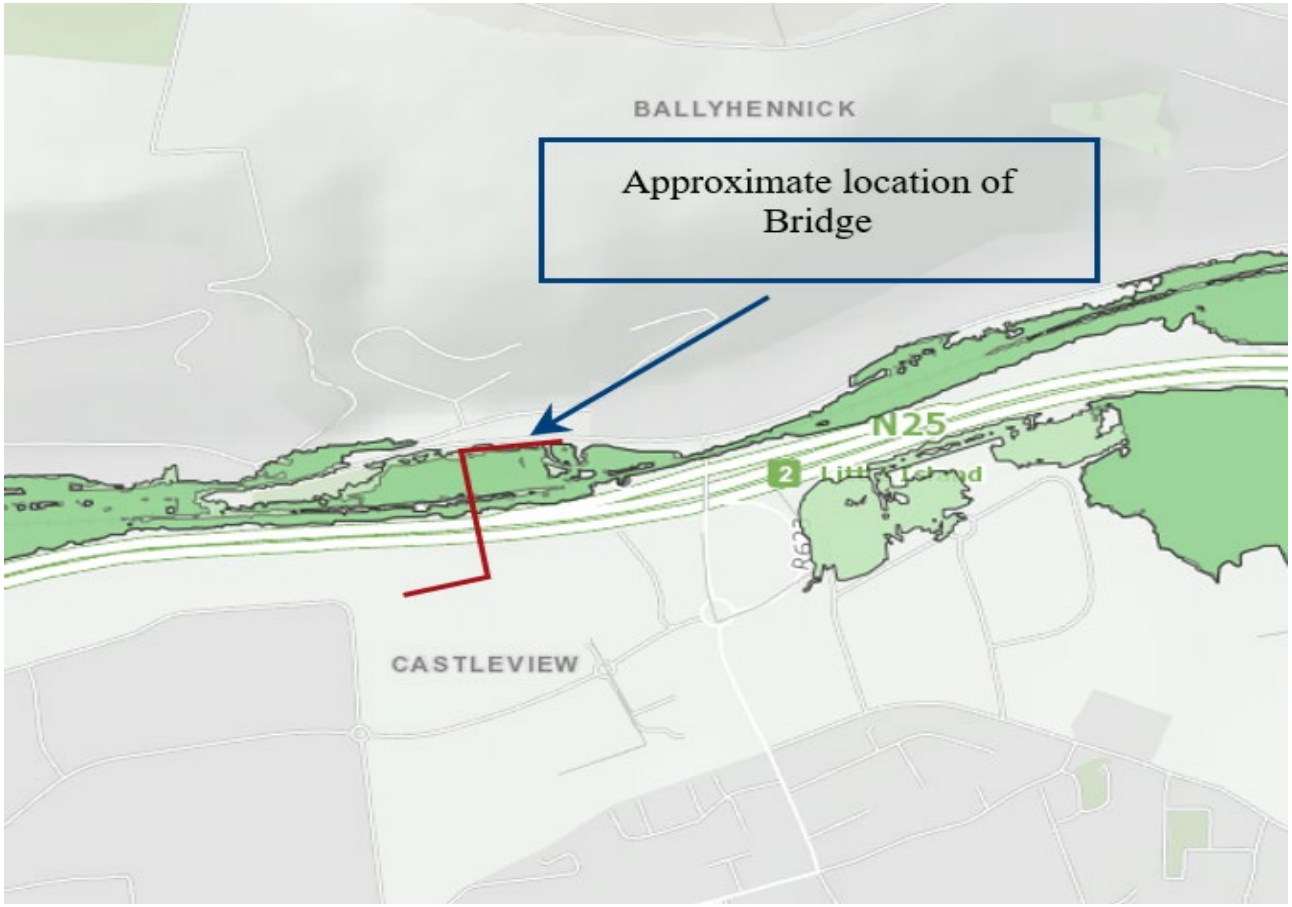

Image 2.3: Extract from South Western CFRAMS coastal flood extents, current scenario (0.5% AEP)

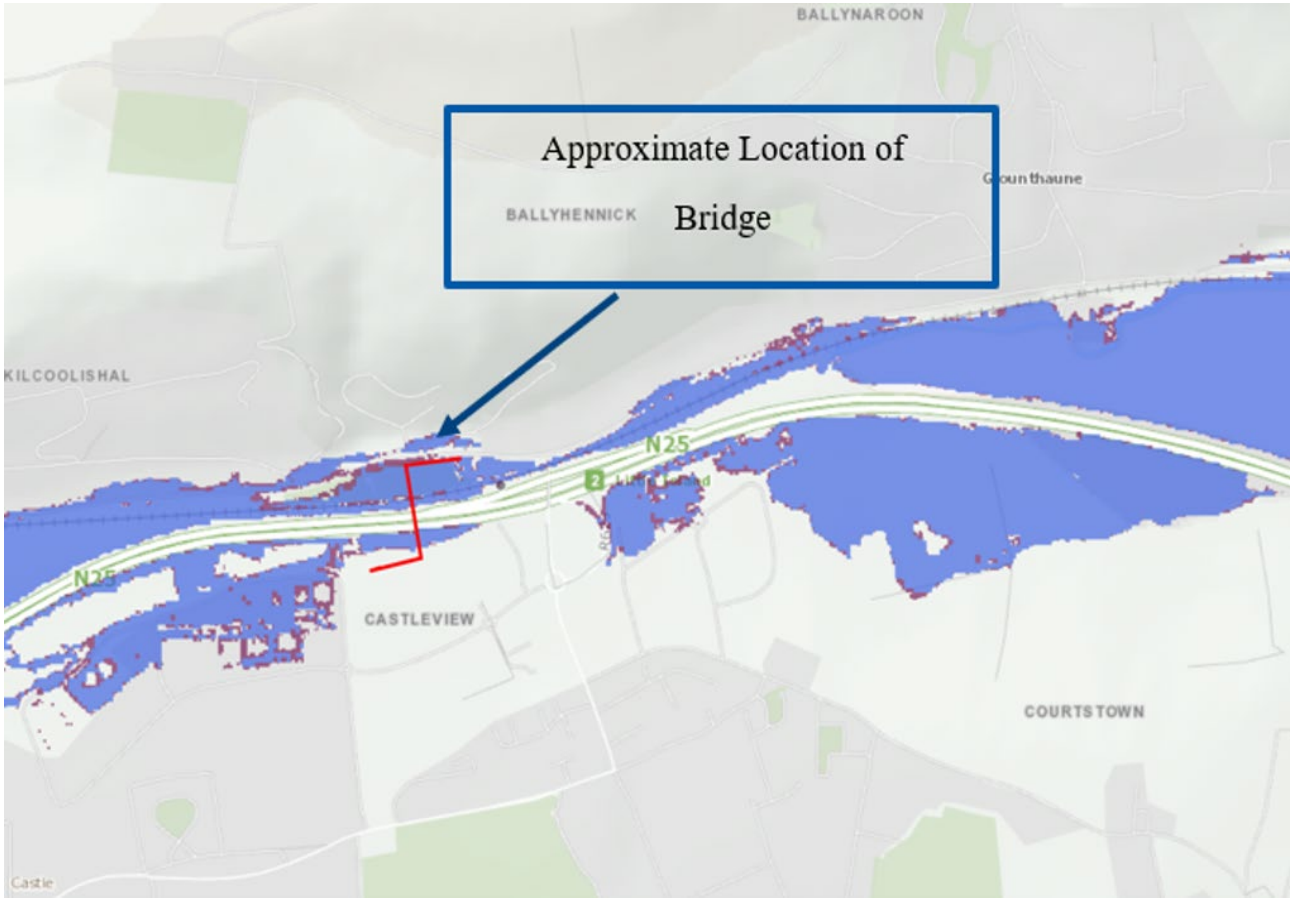

Image 2.4: CCDP 2022 Coastal flood extents, (0.5% AEP)

2.4 Pluvial Flooding

Pluvial flooding occurs when extreme rainfall overwhelms drainage systems or soil infiltration capacity, causing excess rainwater to pond above ground at low points in the topography.

To assess the risk of pluvial flooding to the Proposed Development, Preliminary Flood Risk Assessment (PFRA) flood maps produced by the OPW were reviewed and are presented in **Image 2.5**. The PFRA map indicates that the site is at low risk of pluvial flooding. However, these maps are preliminary and are only indicative. The risk level may change if the drainage system is overwhelmed or blocked.

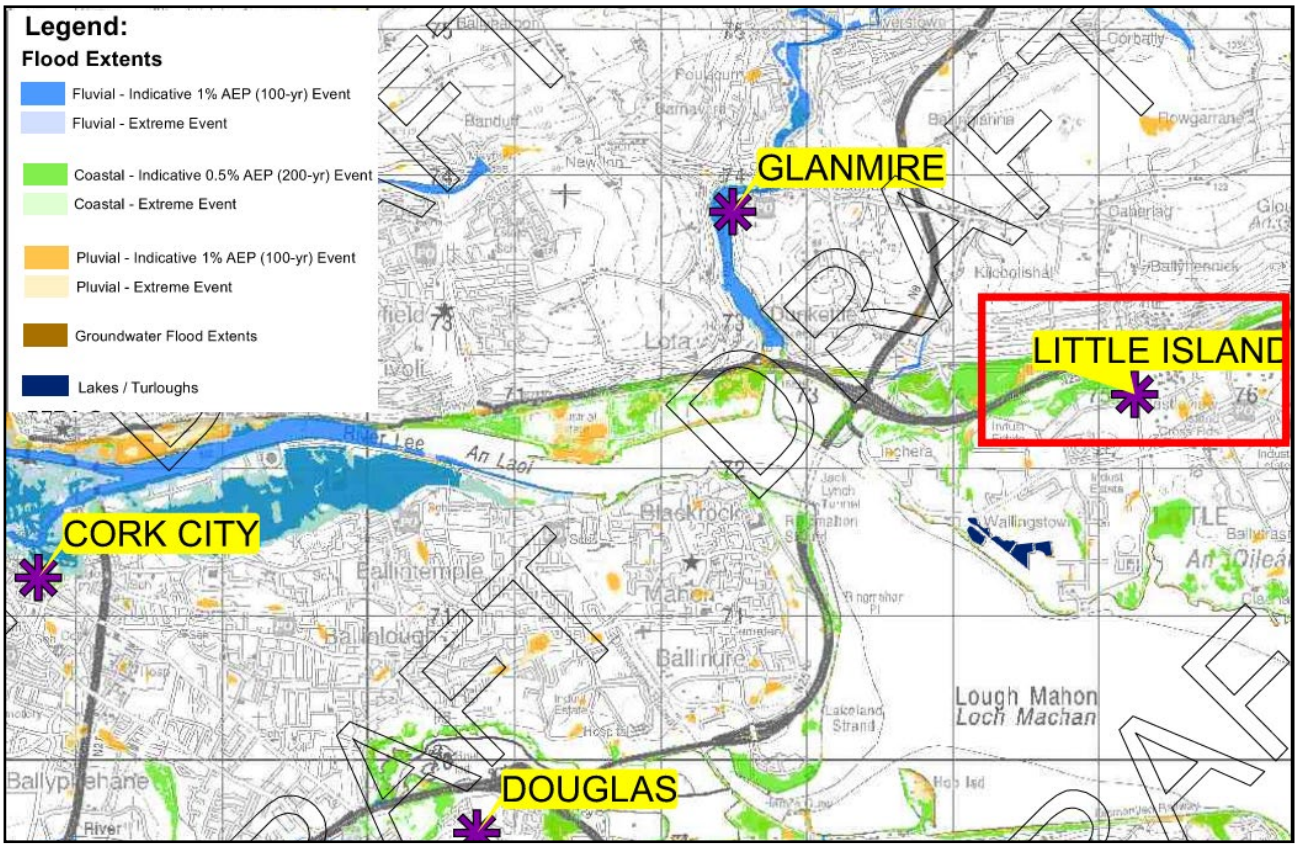

Image 2.5: Preliminary Pluvial Flood Risk Mapping of under study area-Little Island

2.5 Groundwater Flooding

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during late winter / early spring when the groundwater table is already high. If the groundwater level rises above ground level, it can pond at local low points and cause periods of flooding.

The risk of groundwater flooding at the site has been assessed using the Geological Survey Ireland (GSI) Groundwater Flooding Probability Maps. Assessment of the GSI flood maps indicates that the Proposed Development will be safe from the 0.1%, 1% and 10% AEP groundwater floods. Refer to **Image 2.6**. According to the map, flood risk from groundwater at the Proposed Development site is low.

In the absence of historic flooding, the risk from groundwater flooding is likely to be low. It is however recommended that ground water level at the site is monitored to allow better assessment of groundwater flood risk including during the Construction Phase.

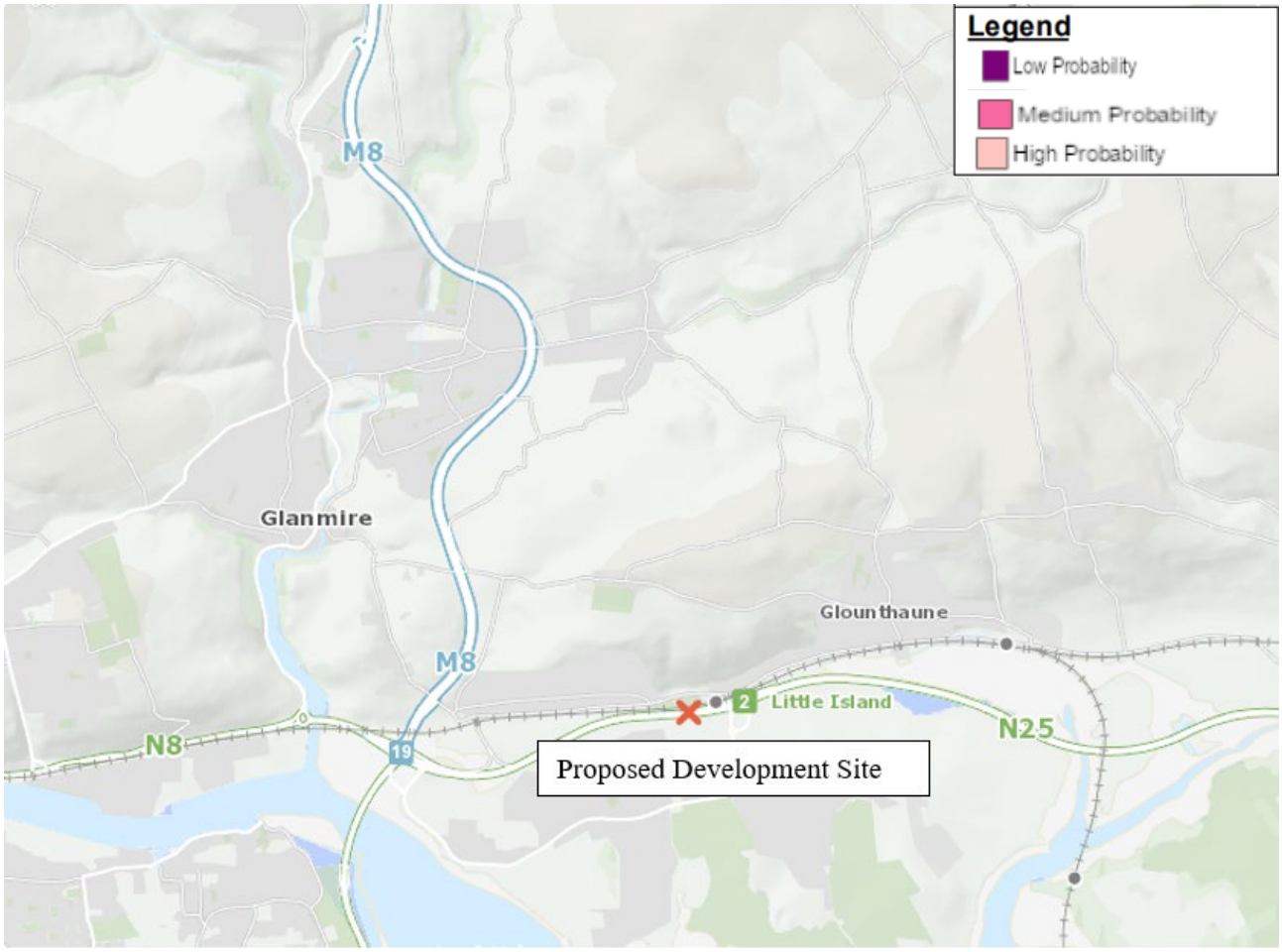

Image 2.6: Groundwater Flood Risk Map (source: www.floodinfo.ie)

2.6 Conclusion of Stage 1 FRA

An assessment of the potential flood risk to the site has been carried out. The conclusions from the assessment are as follows:

- There is no record of historical flooding within 500m radius of the Proposed Development site;
- The southern part of the Proposed Development site is located outside of the predicted 1 in 1000-year fluvial floodplain (within Flood Zone C). Fluvial flood risk of the Proposed Development site is therefore deemed to be low;
- The northern part of the Proposed Development site is located within the predicted 1 in 200-year coastal floodplain (within Flood Zone A). The Proposed Development site is therefore at risk of coastal flooding at this location;
- The risk of pluvial flooding to the site is low. However, the risk of flooding from surface runoff may affect the site if the drainage system is overwhelmed or blocked; and
- The risk of groundwater flooding to the site is considered low. However, monitoring of groundwater levels at the site as part of the site investigations may be required.

Therefore, it is concluded that it is necessary to progress to Stage II FRA to examine further flooding from the coastal source.

3. Stage 2 – Initial Flood Risk Assessment

A Stage 2 FRA (initial flood risk assessment) was undertaken to:

- Confirm the sources of flooding; and
- Appraise the adequacy of existing information as identified under Stage 1 FRA.

A Source-Pathway-Receptor model was developed to assess the risks from the various sources of flooding. The model provides the likelihood of flooding happening from the specified source and its consequence depending on the vulnerability classification of the Proposed Development.

3.1 Source-Pathway-Receptor Model

A Source-Pathway-Receptor model was developed to summarise all possible sources of flooding, the pathway, and receptor for the Proposed Development site. The analysis provided estimates of the probability and magnitude of the sources, the performance and response of pathways and the consequences to the receptors because of the Proposed Development, as listed in **Table 3.1**.

Table 3.1: Source - Pathway – Receptor Model [1]

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Fluvial	Overbank Flow	People / Property	Remote (1)	Minimal (1)	Low (1)
Coastal	Sea Level Rise	People / Property	Likely (4)	Minimal (1)	Medium (4)
Surface water (Pluvial)	Blockage / Overflow	People / Property	unlikely (2)	Minimal (1)	Low (2)
Groundwater	Rising Water Level	People / Property	Remote (1)	Minimal (1)	Low (1)
Human / Mechanical Error	Operational Failure	People / Property	Remote (1)	Minimal (1)	Low (1)

Table 3.1 indicates that the Proposed Development site is at a low risk of flooding from fluvial and groundwater sources. However, the risk of flooding from coastal source is considered medium. The

[1] Basis of Scores:

- Likelihood:
  Remote (1): less the 0.1% AEP

  Unlikely (2): 0.1% AEP

  Possible (3): 1% AEP Fluvial or 0.5% Coastal

  Likely (4):10% AEP
- Consequence:
  Minimal (1): inconvenience

  Medium (2): damage to property

  High (3): damage to property and injury

  Major (4): Loss of life and damage to property
- Risk: Low (<=3), Medium (b/n 4 and 6), High (>=8), Very High > (12)

information sources identified in Section 1.3 are considered adequate for the purpose of this FRA and hence, no additional information is required to complete the study. Therefore, the Stage 2: Initial Flood Risk Assessment was completed to confirm the sources of flooding, to determine what further assessments might be required to address the flood risk issues, to propose mitigation measures and to determine residual risks, if any, to the Proposed Development.

3.2 Assessment of Coastal Flood Risk

The maximum water level at the nearest node upstream (approximately 2km) of the existing bridge for the 0.5% AEP coastal flood event level is 2.86m OD. While this is far north from the Proposed Development site, the water levels are considered conservative for use at the site.

The lowest point on the footway / cycle way ramp on the northern side of the Proposed Development is at 2.526m OD (refer to **Image 3.1**). This will result in the submergence of the northern ramp to an approximate depth of 334mm at the entry. The lowest point at southern ramp is at 3.40m OD which is higher than the 0.5% AEP flood level. The southern ramp is at a considerable distance west of the Kilcoolishal Stream, within the grounds of the Eastgate Business Park, and is culverted for most of its length before draining to Cork Harbour. Hence, there is a low risk of flooding.

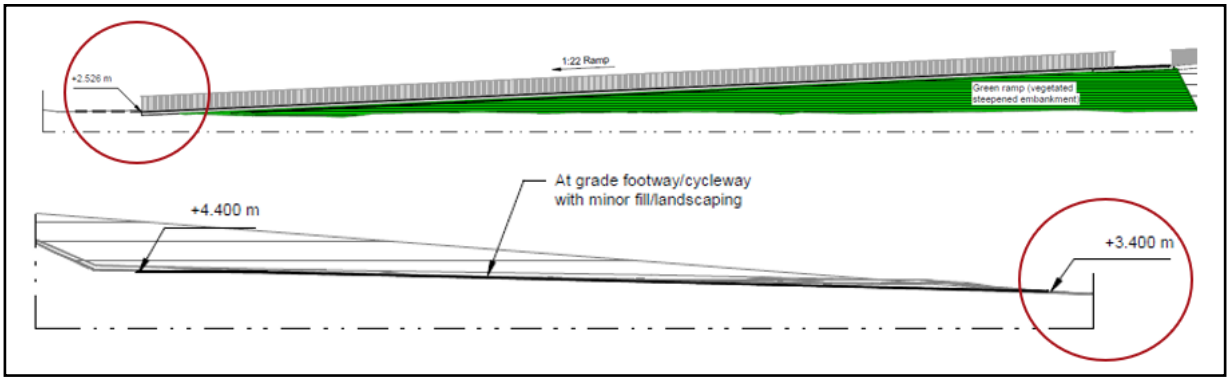

Image 3.1: Northern and Southern Approach Ramps

As the shown in **Figure 2.3**, that the northern ramp of the bridge lies in Flood Zone A where the probability of flooding from the sea is highest (greater than 0.5% or 1 in 200 for coastal flooding). Therefore, a Justification test is required to ensure suitability of the Proposed Development.

3.3 Development Management Justification Test

As the Proposed Development is a pedestrian and cyclist bridge, the vulnerability class is considered “less vulnerable” as it does not represent critical infrastructure. However, the Proposed Development is required to satisfy the Justification test requirements, in accordance with Guidelines, as a section of it is in Flood Zone A. **Table 3.2** presents the assessment and results of the Justification Test as applied to the Proposed Development.

Table 3.2: Justification Test

No.	Criteria	Response	Criteria Satisfied
1	The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.	The Proposed Development is located within an ‘Industry’ and ‘Green Infrastructure’ zone as per the Cork County Development Plan (2022-2028). This development achieves both zoning objectives. The proposed bridge is designed to be seamlessly incorporated and enhance the green corridor.	Yes
2	The proposal has been subject to an appropriate flood risk assessment that demonstrates:		

No.	Criteria	Response	Criteria Satisfied
2(i)	The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.	The FRA completely demonstrated that the Proposed Development does not increase the risk of flooding elsewhere as the source of flooding is coastal and the water level rise due to the submergence of a small section of the bridge will not impact on the surrounding flood level.	Yes
2(ii)	The development proposal includes measures to minimise flood risk to people, property, the economy, and the environment as far as reasonably possible.	The Proposed Development take only a very small section of the coastal floodplain area and the embankments with the sides grassed. Therefore, no risk identified that justify a mitigation.	Yes
2(iii)	The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and	The maximum flood depth in flooded areas can reach up to 3.66m OD. Whereas the lowest access point on the northern ramp is 2.528m OD, access to the bridge from the southern side ensure that access and egress to the bridge is not impacted. The Proposed Development will also integrate with the local surface water drainage system and hence does not impact on flood risk. Moreover, the bridge will not be open for the public, except for emergency personnel, during flood events. .	Yes
2(iv)	The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	The Proposed Development will facilitate sustainable urban growth through the provision of upgraded cultural heritage and public realm spaces. This is in line with the Cork County Development Plan objectives which states *"To Plan for and support the sustainable long-term development of County Cork as an integrated network of vibrant socially and economically successful urban settlements and rural communities, metropolitan and town greenbelts and open countryside, supporting and contributing to the economic development of the County and of the Southern Region.*". The development is in keeping with the landscape and visuals of the river landscape.	Yes

3.4 Conclusion of Stage 2 FRA

The preceding assessment indicated that the norther section of the Proposed Development site is in Flood Zone A from coastal source. The Justification test completed indicated that it satisfies all the criteria and hence, the Proposed Development is appropriate at the proposed location. It is concluded that the flood risk does not need to be mitigated any further, and hence, a Stage 3 FRA was not required.

4. Conclusion and Recommendations

A site-specific FRA was completed as required in the Guidelines for the Proposed Development site. A section of the northern ramp of the Proposed Development is located within Flood Zone A from coastal flooding. As the development is “less vulnerable” a Justification Test was required to be completed. This test indicated that all the justification criteria are met without the need for mitigation measures.

The risk of flooding from other sources is considered low. However, with respect to the pluvial flooding, it is recommended that the approach ramps are positioned without blocking surface water drainage pathways. It is also recommended that surface drainage systems are in accordance with the CIRIA SUDS Manual (C753) or equivalent guideline.

It is concluded the flood risk to the site from all sources can be managed without increasing flood risk elsewhere and therefore, the Proposed Development complies with DoEHLD / OPW guidance.

5. References

Cork County Council (CCC) (2022). Cork County Development Plan 2022-2028.

Geological Survey of Ireland (GSI) (2018). Groundwater Vulnerability Mapping. Available at: www.gsi.ie

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